ORGANIZATIONAL STRUCTURE OF TELEHEALTH CARE:

AN EXAMINATION OF FOUR TYPES OF TELEMEDICINE SYSTEMS

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ABSTRACT

The purpose of this study is to make recommendations for a sustainable telemedicine system by examining the structural attributes of telemedicine across and within different types of organizations. A survey instrument with two categories, background questions and evaluation questions, was developed and used as a guide to interview eight key informants from four different types of telehealth systems. The eight transcribed interviews were coded using NUD*IST qualitative software. Research publications, archival documents, and government reports were collected to triangulate, or cross check, interview data. Multi-case study methodology was used as a guide to design the research, analyze date, compare results, and make recommendations.

A telehealth typology is proposed as well as a simplified conceptual telehealth model and a diffusion of telemedicine model.

While there are some structural differences among the different types of programs, there are many more similarities. All receive funding from multiple sources, and all employ a combination of full and part-time employees. Three core staff categories include administrative, medical, and technical support. Additional categories may include evaluation researchers and project coordinators.

Major barriers to the development or maintenance of a telehealth system are identified as telecommunication costs and lack of infrastructure; physician

participation, both referring and providing; concerns about profitability and liability; and lack of internal support and resistance to change.

Factors of organizational structure identified as conducive to growth and sustainability of a telehealth network include: development of a statewide, multi-use network; an advisory oversight group composed of key players in state government, higher education, telecommunications, and healthcare educators; integration of the network into desktop environments; multiple funding strategies; internal support and marketing and external marketing.

Recommendations for developing, growing, and sustaining a teleheatlh network are provided as well as recommendations for further research.

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CHAPTER I

INTRODUCTION

"The future of medicine is telemedicine."

C. Everett Koop, M.D., Sc.D.[1]

"Telemedicine does not create new or different health care services. It simply provides a revolutionary way to deliver existing medical or health care services."

Senator Bill Frist, M.D.[2]

Health care in the United States is in the midst of a paradigm shift, from a traditional provider-centered, disease-oriented approach to a patient-centered, health-management model. This paradigm shift is in part due to the use of interactive, audio-visual telecommunication technologies to deliver health care services.[3] This delivery system is known as telemedicine.

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[1] C. Everett Koop quoted in "Telemedicine: A Promising Dream Faces Harsh Realities," by H.L. Blatt. Available at gsulaw.gsu.edu/lawand/papers/su98/telemed/.

[2] Sen. Bill Frist, Chairman, Subcommittee on Science, Technology and Space, "Opening Statement, Hearing on Telemedicine Technologies," (September 15, 1999). Available at http://www.senate.gov/~commerce/hearings/0915fri.pdf

[3] John Haughton, "A Paradigm Shift in Healthcare: From Disease Management to Patient-Centered Systems," *MD Computing* (July/August 2000), 34-38. Available at www.mdcomputing.com/issues/v17n4/haughton.htm.

Thomas, S. Kuhn, *The Structure of Scientific Revolutions* (Chicago: University of Chicago Press, 1962), 10.

According to the 1997 *Telemedicine Report to Congress*, "Telemedicine can mean access to health care where little had been available before …. Telemedicine has the potential to improve the delivery of health care in America by bringing a wider range of services, such as radiology, mental health services, and dermatology to underserved communities and individuals in both urban and rural areas." [4]

Problem Statement

Although telemedicine has been touted as an answer to the disparity in access to health care in the United States, use of telemedicine by health care professionals has been uneven. Although telemedicine activity has been reported in forty-eight states, only nine states accounted for 50 percent of the activity in 1998. Only fifty telemedicine programs accounted for almost 60 percent of total telemedicine activity.[5]

In order to understand why and how telemedicine systems may be implemented, sustained and grown, it would be useful to examine the infrastructure of several different types of benchmark telemedicine networks that have been identified and commonly accepted as successful in developing and using telemedicine to improve access to health care.

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[4] United States Department of Commerce and United States Department of Health and Human Services. *Telemedicine Report to Congress* (January 31, 1997). Available at www.ntia.doc.gov/reports/telemed/.

[5] Bill Grigsby and Nancy Brown, *1999 Report on U.S. Telemedicine Activity* (Portland: Association of Telehealth Service Providers, 2000), iv, 4.

Purpose of the Study

This dissertation focuses on telemedicine delivery systems, including allied telehealth activities. It examines the infrastructure of telemedicine across and within different types of organizations and, from this, develops recommendations for network development, sustainability and growth.[6] In addition, a survey instrument was developed to determine organizing infrastructure on a nationwide basis.

Research Method

To understand the diversity of organizational settings in which telemedicine networks are now situated, this research examines networks that are located in the following organizations: academic medical centers; non-academic medical centers; statewide telemedicine networks; and telemedicine networks located within a health insurance company.

The case study method is used to determine the organizational structure and location of the telemedicine network within the larger "parent" organization. The original purpose of the networks is examined, as well as the history of their development and factors that contributed to and detracted from network development. Such factors as funding sources; health care provider and patient acceptance; technical factors; location within the parent organization; availability or non-availability of reimbursement; and other factors that were discovered through in-depth interviews with key informants

within the telemedicine network under study. Key informants were chosen based on their length of stay within the network and by recommendations from personnel within the network under study and from personnel in other networks.

Research Questions

The following research questions were used to guide the research (see Appendix 2: Survey Instrument):

1. What is the organizational structure of an academic institution/school of medicine telemedicine network versus a non-academic institution/school of medicine telemedicine network versus a statewide telemedicine network versus an insurer-run telemedicine network? What is the hierarchical structure, funding source(s), type and level of staffing?

2. What kinds of human resources are necessary, and what roles must they play? What capabilities are necessary?

3. What are the organizational problems and barriers of building, maintaining, and sustaining a telemedicine network?

4. What organizational structure is most conducive for success in a telemedicine network? Success can be defined as sustainability, full use, increased access

[6] In this study, the term "growth" refers to growth in the numbers and types of telemedicine or telehealth encounters.

and diversity of services offered. The definition of success will be determined by the key informants of a particular telemedicine network.

Limitations of the Study

A large area of telemedicine is military telemedicine, which the federal government has funded and promoted as a way to improve access to primary care, specialty consultations, and battlefield medicine with a limited number of military health professionals. The study of the organization and use of telemedicine in the military is beyond the scope of this study. This research will focus on civilian applications of telemedicine in the United States.

Prison telemedicine services a unique population that is not excluded from this study, but will be examined in the context of being part of a larger telemedicine network.

There has been some criticism of case study research, in that it relies heavily on qualitative data such as interviews with key informants. This limitation may be overcome by following research protocol and by triangulating, or cross-checking, data from key informants with other published data and archival records. While this may assure accuracy of the data presented, the completeness of the data is dependent upon the skills and thoroughness of the researcher.

Note

At the time of this study, the terms “telemedicine” and “telehealth” are generally accepted and are not hyphenated. Less familiar sub-disciplines, such as tele-dermatology or tele-radiology are hyphenated for clarity and consistency.

CHAPTER II

REVIEW OF THE LITERATURE

A review of the research literature covers five main areas: background information about telemedicine; the involvement of the federal government in the development of telemedicine programs as a strategy to address medically underserved populations; the adoption of technology by health care organizations and health care providers, and telemedicine theory. Finally, case studies and surveys of telemedicine networks are reviewed to demonstrate the research that has been done in this area and to justify the need for continuing research.

Telemedicine

Definition

While there is not yet a definitive or universally accepted definition of telemedicine, the word itself implies the use of telecommunications for medical purposes. The word *telemedicine* derives from the words *tele*, Greek for "far off," and the Latin *medicus* or physician, so telemedicine may be defined literally as "medicine practiced from a distance."

Reid defines telemedicine as "the use of advanced telecommunications technologies to exchange health information and provide health care services across

geographic, time, social, and cultural barriers" and insists it is not a new discipline within medicine, but "a new way of doing the same old things."[7]

Telemedicine is defined by Perednia and Allen as "the use of telecommunications technologies to provide medical information and services."[8] However, they also note: "Although this definition includes medical uses of the telephone, facsimile, and distance education, telemedicine is increasingly being used as shorthand for remote electronic clinical consultation."[9]

Bauer and Ringel have called telemedicine the seventh revolution in healthcare in the modern era. They propose the following timeline:

1. Anesthesia – 1840s
2. Scientific Disease Model and Public Health – 1860s-1880s
3. Radiology and Diagnostic Imaging – 1890s
4. Medical Education Reform – early 1900s
5. Antibiotics and Prevention – 1920s
6. Genetics and Pharmaceuticals – 1980s
7. Telemedicine and Telehealth – 1990s[10]

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[7] Jim Reid, *A Telemedicine Primer: Understanding the Issues* (Topeka KS: Innovative Medical Communications, 1996), 10, 13.

[8] Douglas A. Perednia and Ace Allen, "Telemedicine Technology and Clinical Applications," *Journal of the American Medical Association* (February 8, 1995), 483.

[9] Perednia and Allen, 483.

[10] Jeffrey Bauer and Marc Ringel, *Telemedicine and the Reinvention of Healthcare* (New York: McGraw-Hill, 1999), 59-74.

Typology

As in every new area of research, a descriptive typology is being developed to organize and categorize the various aspects of telemedicine and telehealth. Some use the two terms interchangeably, but the term "telemedicine" implies the use of telecommunications for medical consultation, diagnostic or treatment purposes. "Telehealth" implies the inclusion of preventive measures, patient education and/or monitoring for the maintenance of health.

Technology Typology

Brown, of the Telemedicine Information Exchange, classifies telemedicine as a sub-category of E-Health. It is "a general term encompassing health care delivery, administration and information dissemination."[11] Telehealth implies the use of more traditional telecommunications technology, such as video-phones while E-health implies the use of computer technology. Telemedicine, in turn, may be divided into two types: (1) store and forward for "transferring digital images from one location to another" and (2) two-way interactive television used when "a consultation between the patient, primary provider, and specialist is necessary."[12]

[11] Nancy Brown, "Telemedicine Coming of Age," *Telemedicine Research Center* (September 28, 1996). Available at trc.telemed.org/telemedicine/primer.asp.

[12] Brown. trc.telemed.org/telemedicine/primer.asp.

A third technical category, virtual or 3-D technology, is futuristic although some work is being conducted in the area of robotic surgery (Figure 1).

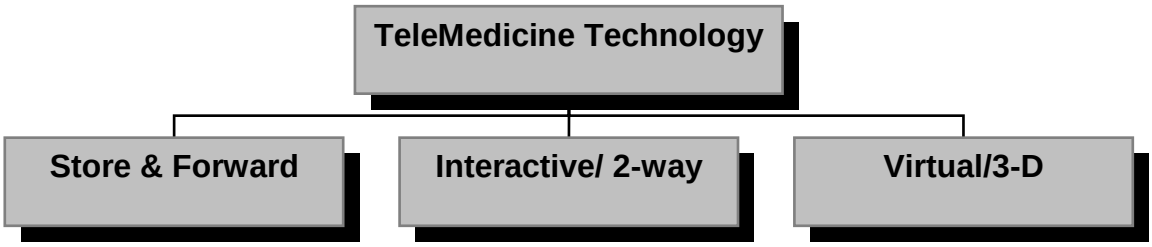

Figure 1.
Typology of Telemedicine Technology

Pombortsis proposes a more complex two-dimensional typology of medical telecommunications applications according to data volume and level of interactivity (Figure 2).

User Typology

Brauer also categorizes telemedicine and tele-education as subsets of telehealth, but from a user perspective. He defines telemedicine as, "*patient-care-oriented* clinical, diagnostic and therapeutic activities" and tele-education as, "*provider-oriented* services, such as access to information and linkages with other practitioners."[13]

Applications Typology

The National Library of Medicine categorizes telemedicine into three basic areas: aides to decision-making (remote expert systems or databases); remote sensing or tele-transmission of patient data; and real-time interaction of patients and health care providers.[14] In a survey of telemedicine research, Taylor divides telemedicine services similarly into three broad categories: 1) treatment services, 2) diagnostic or management services, and 3) educational services.[15]

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[13] Gerhard W. Brauer, "Telehealth: The Delayed Revolution in Health Care," *Medical Progress Through Technology* (1992), 151-63.

[14] Kristine M. Scannell, Douglas A. Perednia and Henry M. Kissman, *Telemedicine: Past, Present, Future: January 1966 through March 1995* (Washington, D.C.: National Library of Medicine, 1995). Available at www.nlm.nih.gov/pubs/cbm/telembib.html.

[15] Paul Taylor, "A Survey of Research in Telemedicine 2: Telemedicine Services," *Journal of Telemedicine and Telecare* (1998), 63-71.

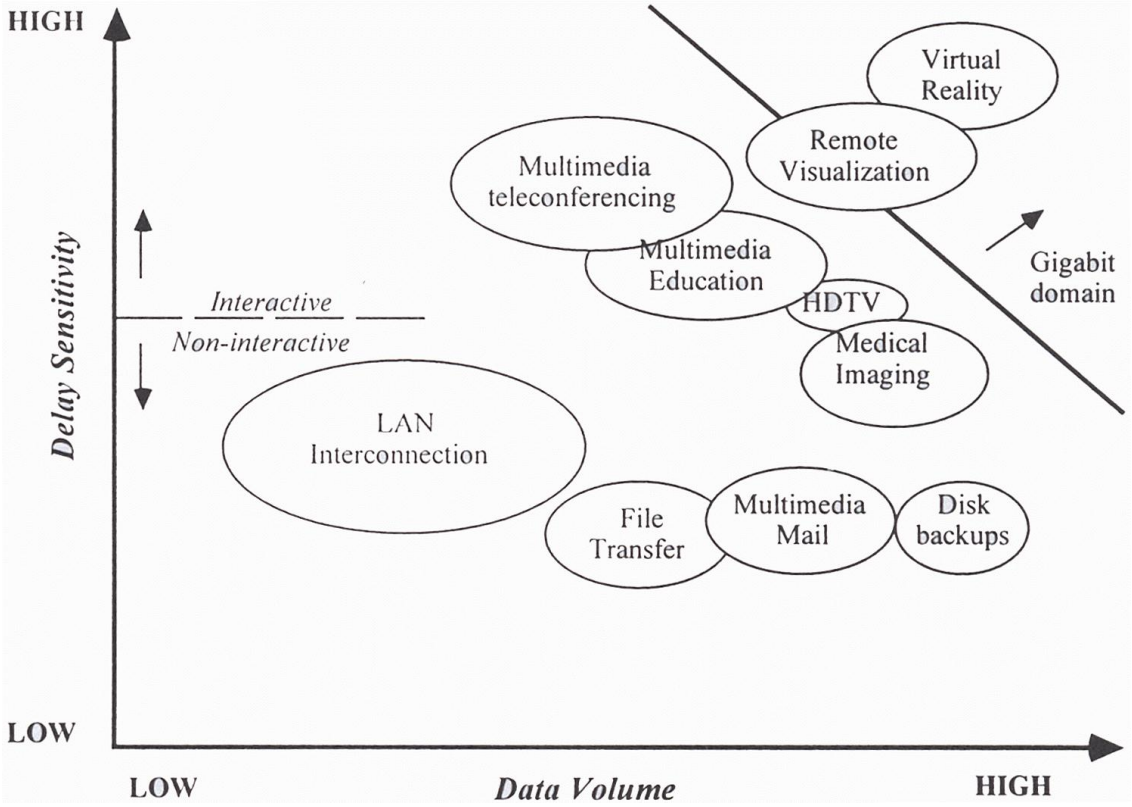

Figure 2.
Pombortsis' Typology of Medical Telecommunications Applications[16]

Grigsby et al. classified clinical applications of telemedicine into nine categories of general applications and processes:

1. Initial urgent evaluation and triage
2. Medical and surgical follow-ups
3. Primary care consultations
4. Specialty consultations and second opinions
5. Transmission of digital diagnostic images

[16] Andreas S. Pombortsis, "Communication Technologies and Applications in a Medical Environment" in I. Iakovidis, s. Maglavera, and a Trakatellis, eds., *User Acceptance of Health Telematics Applications* (Washington, D.C.: IOS Press, 1998), 184.

6. Diagnostic work-ups for specific conditions
7. Monitoring of chronic diseases and conditions
8. Transmission of medical data
9. Public health and education.[17]

Comprehensive Typology

A comprehensive classification system is detailed by Reid who categorizes telemedicine according to level of service, setting, health care discipline, technology, equipment, data type, and activity:

1. Level of service (tele-consultation, tele-care, tele-monitoring, telehealth)
2. Settings/end-user locations (hospital, clinic, home, prison, workplace)
3. Healthcare discipline (medical specialty, nursing, allied health)
4. Technology system(s) (interactive video, store and forward)
5. Equipment used (room systems, rollabouts, PCs, mobile, set-top boxes)
6. Technology data (data, audio, graphics, video, virtual tele-presence)
7. Activity (clinical, educational, administrative, business).[18]

The telemedicine typology of Grigsby et al. maps to Reid's typology system in two areas: level of service and healthcare discipline.

Reid 1. Level of service

Grigsby et al. 1. Initial urgent evaluation and triage

2. Medical and surgical follow-ups

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[17] Jim Grigsby, Robert E. Schlenker, Margaret M. Kaehny, Peter W. Shaughnessy, and Elliot J. Sandberg, "Analytic Framework for Evaluation of Telemedicine," *Telemedicine Journal* 1 (1995), 36-37.

[18] Jim Reid, "Telemedicine Applications: Today and in the Future," slide presentation (1998). Available at www.telemedprimer.com/htb1198/tsld001.htm.

5. Transmission of digital diagnostic images
6. Diagnostic work-ups for specific conditions
7. Monitoring of chronic diseases and conditions
8. Transmission of medical data

Reid 3. Healthcare discipline

Grigsby et al. 3. Primary care consultations
4. Specialty consultations and second opinions

Proposed Typology Model

A typology model of telehealth and telemedicine (Figure 3) is proposed based on types of general healthcare services offered by nurses and allied healthcare workers (Tele-Monitoring, Tele-Nursing, Tele-Allied Care); primary care and specialty physicians (TeleMedicine, Tele-Consultation, Tele-Diagnosis, Tele-Treatment); and healthcare educators and administrators (Tele-Education for providers and/or patients, Tele-Administration, and Tele-Business related to healthcare).

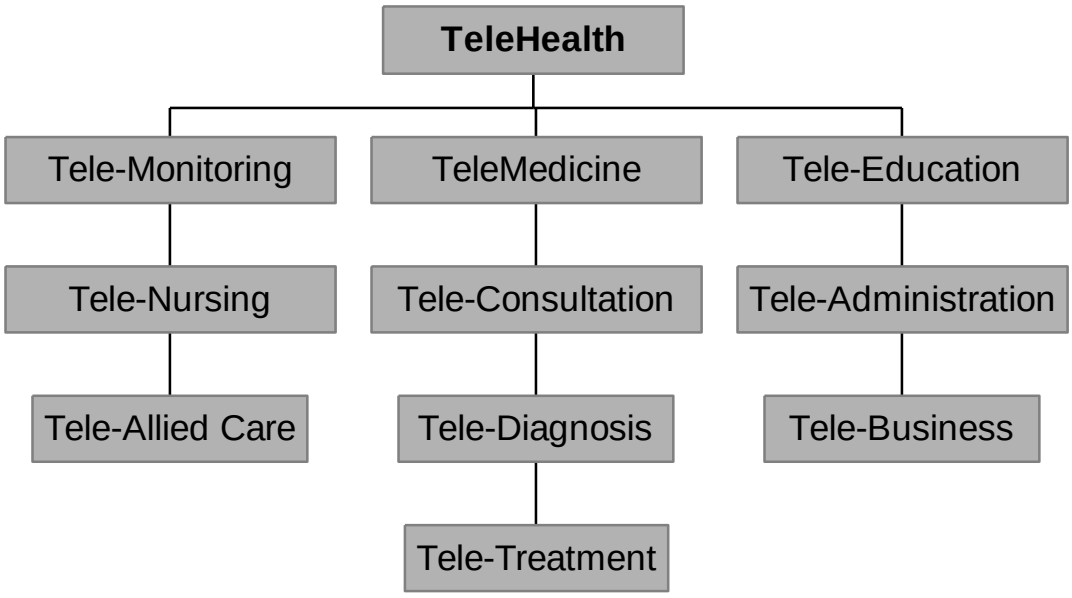

Figure 3.
Typology of Telehealth

Tele-monitoring, Tele-nursing

Tele-monitoring, tele-nursing, and tele-allied care have been shown to be effective in improving and maintaining patients with chronic disease.

A pilot telemedicine project in Scott County, Tennessee, affiliated with Mountain Peoples Clinic, monitored two groups of patients, a group of congestive heart failure patients (CHF) and a group of diabetic patients. Telemedicine equipment installed in the patients' homes included a television monitor, a telephone, a camera and ViaTV

converter equipment to provide real-time, audio-video home health consultations with the telemedicine nurses using plain old telephone system (POTS) lines.

The CHF patients received tele-monitoring equipment: three-lead EKG, blood pressure, pulse and blood oxygen saturation levels. Using store-and-forward technology, results were sent to the Scott County Telemedicine Center each week over POTS lines. In addition, standardized weight scales were given to each patient so the nurse could monitor their weight.

Diabetic patients were given Accu-check blood glucose monitors to store-and-forward their blood glucose levels via POTS lines.

Tele-monitoring of CHF patients reduced the number of acute heart failure episodes and significantly reduced the number of hospitalizations. Tele-monitoring of diabetic patients resulted in a 200 percent increase in those who have their blood sugar under control.[19]

Clinical Telemedicine, Tele-Consultations

The University of Tennessee TeleHealth Network conducts specialty consultations with patients in smaller hospitals and clinics in the East Tennessee region. The patient, accompanied by a nurse at the spoke site, is located in a telemedicine examination room equipped with a monitor and digital audio-visual equipment. A

[19] Susan L. Dimmick, Samuel G. Burgiss, and Sherry Robbins, "Differences in Communication Mode in a Home Telehealth Project for Diabetics." Poster paper presented to the American Telemedicine Association, Fort Lauderdale, FL (February 2001). Selected as a top scientific poster paper.
Samuel G. Burgiss and Susan L. Dimmick, "Telehealth in Home Health Care," In *Telecommunications for Nurses: Providing Successful Distance Education & Telehealth*, 2nd Edition, M.L. Armstrong and S. Frueh, eds. New York: Springer Publishing, 2002.

medical specialist, such as a dermatologist, at the UT Medical Center Telemedicine Department can have an interactive encounter with the patient and attending nurse.

Dedicated high-bandwidth phone lines allow a clear, detailed view, and the specialist, with the attending nurse's assistance, may zoom in for a closer view or may order tests to be done at the local site. Medical records are easily faxed to the specialist and doctor's orders and prescriptions faxed back to the patient.

Origins and Development

While the technology for two-way, interactive audio-video communication has been in existence since the late 1950s, it was not until the 1990s that the use of telemedicine to improve access to health care proliferated.

A 1959 article on store and forward tele-radiology documents the transmission of tele-fluoroscopes over coaxial cable by Dr. Albert Jutras in Montreal beginning in 1957.[20] Dr. Cecil Wittson of the Nebraska Psychiatric Institute co-authored a 1956 article on the use of telemedicine for education[21] and a 1961 article on the use of two-way television in group therapy (tele-psychiatry).[22]

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[20] Albert Jutras, "Teleroentgen Diagnosis by Means of Videotape Recording," *American Journal of Roentgenology* 82 (1959), 1099-102.

[21] Cecil Wittson and R. Dutton, "A New Tool in Psychiatric Education," *Mental Hospitals* 7 (1956), 11-14.

[22] Cecil Wittson, DC Affleck, and V Johnson, "Two-Way Television in Group Therapy," *Mental Hospitals* 12 (November 1961), 22-3.

Bashshur cites Bird as the "first pioneer to develop a complete prototype system."[23] The Tele-diagnosis system, first established in 1968, connected Massachusetts General Hospital and Logan International Airport Medical Station with interactive video as well as electronic transmission of electrocardiograms, blood pressures and stethoscope sounds.

Telemedicine was advanced in the early 1960s when, NASA, the National Aeronautics and Space Administration, first put men in space. Physiological measurements of the astronauts were tele-metered from both the spacecraft and the space suits during NASA space flights.[24]

The development of satellite and digital technology to monitor the health status of astronauts has fostered the development of terrestrial applications of telemedicine as well.

A pioneer telemedicine project, STARPAHC, or Space Technology Applied to Rural Papago Advanced Health Care, was developed by NASA to deliver health care to the Papago Indian Reservation in Arizona. The project, which ran from 1972 to1975, was implemented and evaluated by the Papago people, the Indian Health Service, and the Department of Health, Education, and Welfare. The goal was to provide health care to the isolated and medically underserved Papago Reservation. A van, staffed by two native paramedics, was equipped with a variety of medical instruments, including an

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[23] Rashid L. Bashshur, "On the Definition and Evaluation of Telemedicine," *Telemedicine Journal* 1 (1995), 21.

[24] National Aeronautics and Space Administration, "NASA Telemedicine History" (February 6, 1997). Available at http://web.archive.org/web/19970716104306/http://www.it.hq.nasa.gov/~kmorgan/telemed_blue/history/history.html

electrocardiograph and x-ray machine. This mobile unit was linked to specialists at the Public Health Service Hospital by a two-way microwave transmission.[25]

Although STARPAHC was successful in increasing access to health care to a medically underserved population, the project was expensive, and like many of the early telemedicine programs, it died from lack of funding and provider participation.

With the decreasing cost and increasing bandwidth of technologies in the latter half of the 1990s came a renewed interest in telemedicine.

Research Literature

The growth and development of telemedicine as a field of study is reflected in the research literature. Seventy percent of the more than 8,000 documents indexed in the Telemedicine Information Exchange database (tie.telemed.org/) were published between 1995 and 1999 (Figure 4).[26] The six major telemedicine journals identified by TIE began publication since 1994 (Table 1).[27]

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[25] National Aeronautics and Space Administration, "NASA Telemedicine: Terrestrial Applications" (November 22, 1996). Available at http://web.archive.org/web/19970803095856/www.it.hq.nasa.gov/~kmorgan/telemed_blue/history/history_apps.html

[26] Teresa Welsh, "The Literature of Telemedicine: A Bibliometric Study," Poster Presentation, The Association of Library and Information Science Educators Conference, New Orleans, LA. (January 2002).

[27] Ibid.

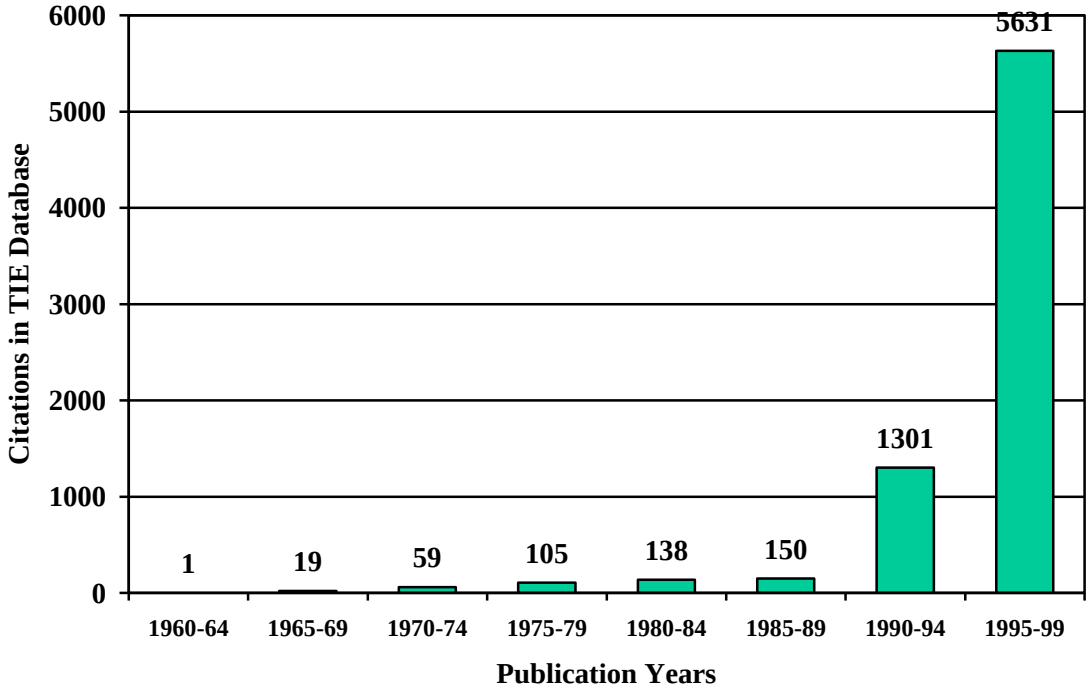

Figure 4.
Growth of Telemedicine Literature, 1960-1999
Number of Citations in TIE Database by Five-Year Increments

Table 1.
Publication Patterns of Six Major Telemedicine Journals
Journal by Number of Citations in TIE per Year, 1994-1999

Journal	'94	'95	'96	'97	'98	'99	Total	Mean
Telemedicine Today	7	24	50	61	82	69	293	59
J Telemed & Telecare		37	101	76	90	101	405	81
Telemedicine Journal		37	35	30	37	121	260	52
Telemedlaw			1	16	20	37	74	25
IEEE IT BioMed				27	26	32	85	28
Telehealth					27	80	107	54
Citations in TIE Database	7	98	187	210	282	433	1,224	50

A systematic review, in 1997 by Balas et al., of clinical trial reports on the efficacy of distance medicine electronic technologies found favorable evidence that these technologies could improve access to healthcare and support quality and continuity of clinical healthcare.[28]

[28] E. Balas, et al., "Electronic Communication with Patients: Evaluation of Distance Medicine Technology," *Journal of the American Medical Association* 278 (July 9, 1997), 152-59.

Current Trends, Uses, and Benefits

The number of telemedicine programs and telemedical encounters in the United States is growing. In 1993, 10 programs performed 1,750 telemedical encounters, an average of 175 per program. In 1999, 179 programs performed more than 70,000 telemedical encounters, an average of 608 telemedical encounters per program (Table 2).[29]

Peter Leitner, industry expert and creator of the Waterford Telemedicine Index, reports that the telemedicine industry worldwide grew from $6.8 billion in 1997 to $13.8 billion in 1998. He cites "increasing consumerism, changing demographics, hardware price deflation and the proliferation of the Internet" as its driving factors. He estimates that telemedicine will represent 15 percent of all health care expenditures by 2010.[30]

Table 2.
Growth of Telemedicine Programs and Activities by Year, 1993-1999[31]

	1993	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**
Number of Telemedicine Programs	10	24	49	86	132	157	179
Number of Telemedicine Encounters	1,750	2,110	6,138	21,732	41,740	52,223	74,828

[29] Grigsby and Brown, 4.

[30] Deborah R. Dakins and Peter Leitner, *The Telemedicine Industry Report 2000* (New York: Waterford, Inc., 2000).

[31] Grigsby and Brown, 4.

The reasons most cited for using telemedicine include increased access to health care, increased quality of health care, and more efficient use of health care resources.[32]

Telemedicine is used in a variety of ways. The telemedicine services with the most use include: specialist consultations, chronic disease management, and medical/surgical follow-ups.[33] The top telemedicine specialty services offered by providers in 1999 include, in order of frequency:

- radiology
- dermatology
- cardiology
- psychiatry
- emergency care
- home health
- pathology
- oncology.[34]

The greatest benefits and lowest costs of medical care are obtained by providing the appropriate level of care at the appropriate time.[35] A study of rural tele-dermatology

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[32] Susan L. Dimmick, Carole Mustaleski, Samuel G. Burgiss, and Teresa Welsh, "A Case Study of Benefits and Potential Savings in Rural Home Telemedicine," *Home Healthcare Nurse* 18 (February 2000), 126.

[33] Grigsby and Brown, 18.

[34] Deborah R. Dakins, "Increased Investment and Incremental Expansion Fuels Optimism," *Telehealth Magazine* (June 1999), 28-31.

[35] Samuel Burgiss, "Telemedicine" Congressional Testimony, *Congressional Record* (September 15, 1999).

patients in the University of Tennessee Telehealth Network reports that fewer tele-consultations with a dermatologist were required for diagnosed skin conditions than for the average number of treatments for the same conditions by a general care provider. The average cost of primary care for skin disease was more than twice that of a specialist's care using tele-dermatology ($294 versus $141).[36]

Two areas of telemedicine that have proven to be particularly cost-effective are correctional telemedicine and tele-homecare. Correctional telemedicine, responsible for about 30 percent of telemedicine activity,[37] can increase inmate access to medical specialists while reducing costs.[38] A study of tele-homecare in rural East Tennessee reported a cost-savings of about $50 per visit for tele-care over a conventional in-home nurses' visit.[39] A similar tele-homecare study in California found a 60 percent savings in time (an average of 18 minutes for a tele-visit versus 45 minutes for an in-person visit). With telemedicine, a homecare nurse could "visit" 15 to 20 patients a day, as opposed to an average in-person daily caseload of 5.2 patients.[40]

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[36] Samuel G. Burgiss et al., "Telemedicine for Dermatology Care in Rural Patients," *Telemedicine Journal* 3 (1997), 230-31.

[37] Grigsby and Brown, 5.

[38] United States Department of Justice, "Telemedicine Can Reduce Correctional Health Care Costs: An Evaluation of a Prison Telemedicine Network" (March 1999). Available at: http://www.abtassoc.com/reports/telemedicine/ES-175040.pdf

[39] Dimmick et al., 129.

In addition to reducing the costs of home care, tele-homecare has been shown to reduce the number of office visits, the number of emergency room visits, the frequency and duration of hospitalizations, and the number of long-term care placements.[41]

Rural telemedicine may have additional benefits to the local community including:

- improved health professional recruitment and retention
- enhanced image of the local health system
- solidified referral relationships
- retention of health care revenues within the local community.[42]

Barriers to Implementation and Use

Despite the benefits, successes and cost savings of telemedicine, the percentage of telemedicine in overall health services is small. Association of Telemedicine Service Providers president, Dr. Douglas Perednia, claims,

> There are relatively few providers who know that telemedicine exists and even fewer healthcare consumers. Our survey reported only 2,108 providers involved in telemedicine in 1997. That's a tiny number compared to the hundreds of thousands of doctors in the United States alone. Probably fewer than 1 percent of U.S. physicians actually deal with telemedicine, and I would be willing to bet that fewer than 5 percent have any working knowledge of it.[43]

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[41] Samuel Burgiss, "Telehealth: A Cutting Edge Medical Tool for the 21st Century," Congressional Testimony, *Congressional Record* (September 7, 2000).

[42] Thomas S. Nesbitt, Jeffrey C. Ellis and Christina A. Kuenneth, "A Proposed Model for Telemdicine to Supplement the Physician Workforce in the USA," *Journal of Telemedicne and Telecare* 5 (1999), S2:21.

[43] Douglas A Perednia, "The Telemedicine Market: An Interview with the ATSP's Doug Perednia, M.D," *Telemedicine Today* 7 (February 1999), 33.

The strength of the challenges facing telemedicine is indicated by the slowing yearly growth rate of telemedicine programs and activity from 1994 to 1999, as opposed to the number of programs per year (Figures 5 and 6).

Barriers perceived by health care providers to the implementation and use of telemedicine include:

- expensive long-distance communication charges
- concerns about provider liability
- concerns about licensing when tele-consulting across state lines
- technology systems incompatibility (hardware and software)
- an absence of standards for telemedicine practice
- concerns about reimbursement for telemedicine patient encounters.[44]

Federal Government and Telemedicine

The federal government has been instrumental in funding telemedicine projects as a way to address the disparity of access to health care services in the United States.

[44] Nesbitt, Ellis and Kuenneth, S2:24.

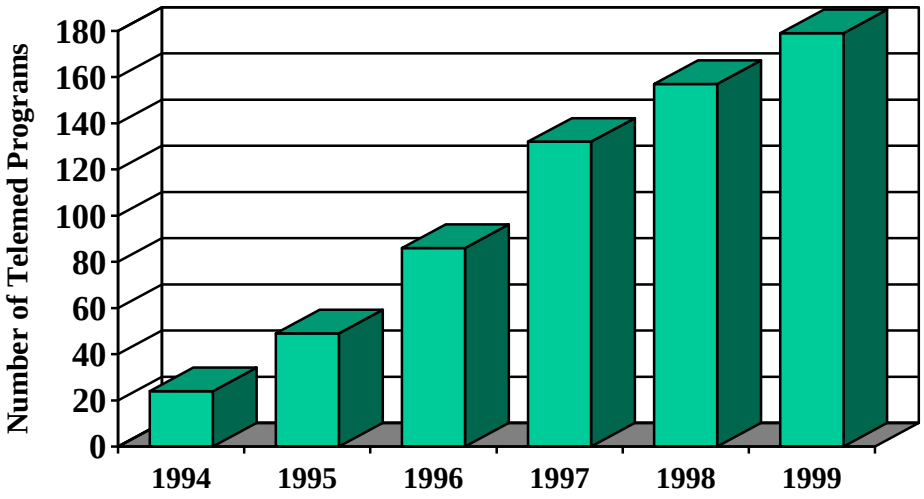

Figure 5.
Number of US Telemedicine Programs by Year, 1994-99

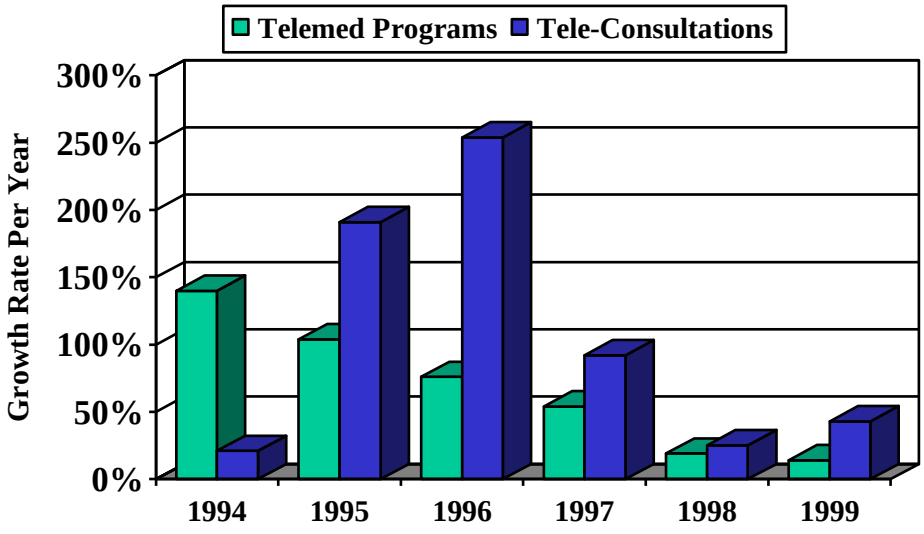

Figure 6.
Growth Rate of US Telemedicine Programs and Activity by Year, 1994-99

Data source for Figures 5 and 6: *1999 Report of U.S. Telemedicine Activity*[45]

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[45] Bill Grigsby and Nancy Brown, *1999 Report on U.S. Telemedicine Activity* (Portland: Association of Telehealth Service Providers, 2000).

In 1990, there were four federally funded telemedicine projects, in 1993, there were ten, and in 1994, at least fifty federally funded programs were either active or in the planning stages.[46]

Mal-distribution of Health Care

Despite massive funding efforts and multiple federal programs since the 1960s, the geographic mal-distribution of access to health care is a persistent characteristic of the American health care system.[47] While the rural population has grown to more than fifty million people (about 20 percent of the U.S. population), only about 9 percent of physicians practice in rural areas (Figure 7).[48]

In addition to having less access to health care, the average rural resident has greater health care needs than does his urban counterpart. Rural populations tend to be poorer, older, less educated, and suffer more from both chronic diseases and acute conditions than the general population.[49] More than 14 percent of rural residents live in poverty (Figure 8) and about 24 percent of rural children live in poverty (compared to 22 percent of urban).[50]

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[46] Perednia and Allen, 5.

[48] Council on Graduate Medical Education, 11.

[49] Thomas A. Pearson and Carol Lewis, "Rural Epidemiology: Insights from a Rural Population Laboratory." *American Journal of Epidemiology* 148 (1998), 949-957.

[50] Economic Research Service, U.S. Department of Agriculture, "Rural Income, Poverty, and Welfare" (December 2000). Available at www.ers.usda.gov/briefing/IncomePovertyWelfare/.

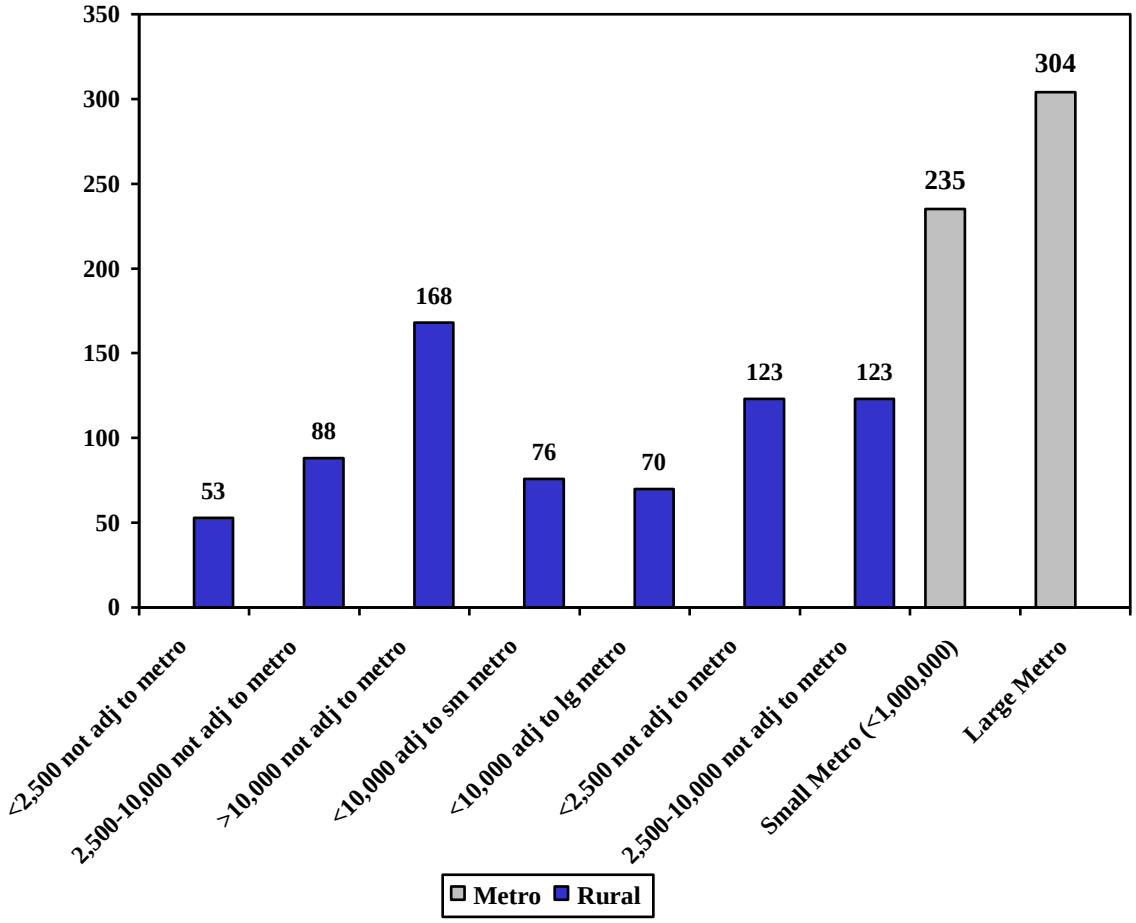

Figure 7.
Physicians Per 100,000 Population
Data source: AMA from BHPr's ARF data, 1997 [51]

[51] Council on Graduate Medical Education, Health Resources and Services Administration, Public Health Service, U.S. Department of Health and Human Services, "Tenth Report: Physician Distribution and Health Care Challenges in Rural and Inner-City Areas" (February 1998), xiii.

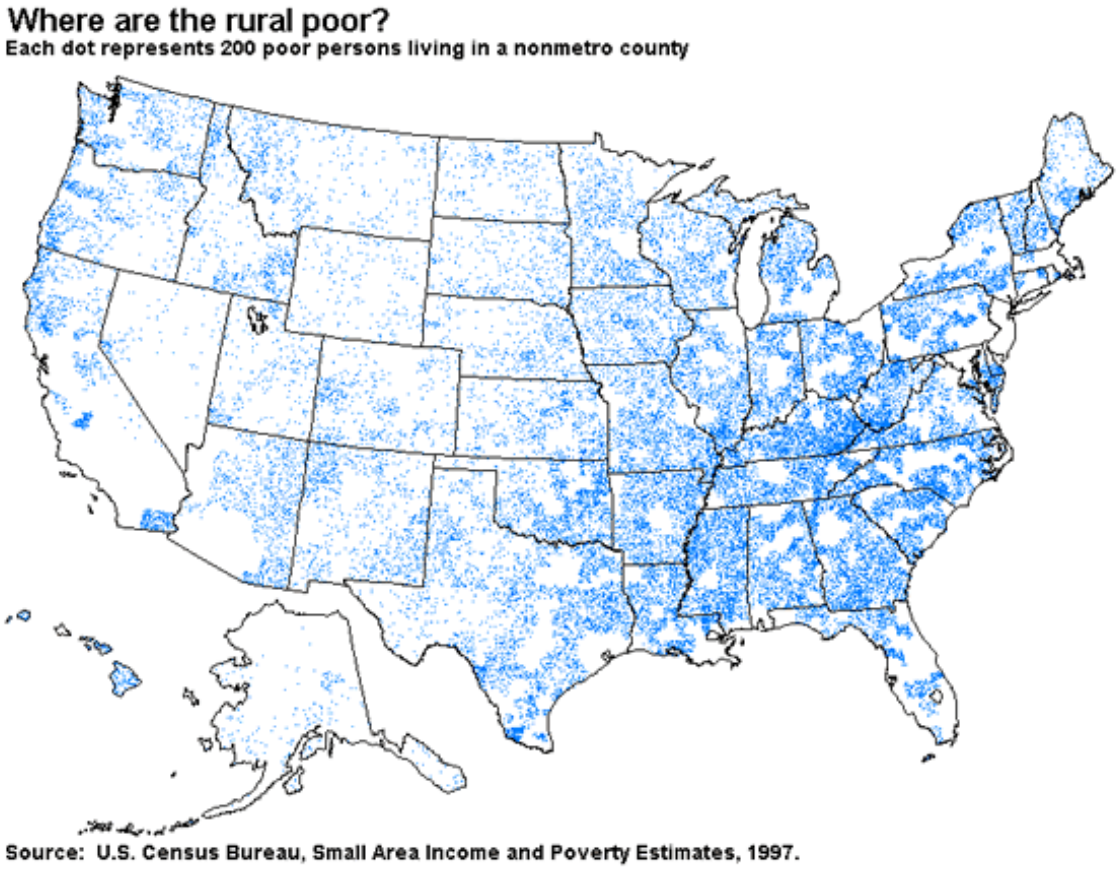
Where are the rural poor?
Each dot represents 200 poor persons living in a nonmetro county
Source: U.S. Census Bureau, Small Area Income and Poverty Estimates, 1997.

Figure 8.
Rural Poor in the United States[52]

[52] Economic Research Service, U.S. Department of Agriculture, "Rural Income, Poverty, and Welfare: Maps and Images Gallery" (November 2000). Available at www.ers.usda.gov/Briefing/rural/Gallery/whpoor97.htm.

Pearson and Lewis note that rurality and low socio-economic status have been shown to be risk factors for acute conditions as well as for chronic illnesses, such as diabetes and coronary disease. Such disease is due to "detrimental trends in health behaviors, a lack of effective health promotion messages and services, a crisis in access to rural primary health care, and limitations in rural emergency medical systems."[53] In addition, "rural communities appear to be late adopters of positive health behaviors."[54]

In 1970, to address the problem of health care mal-distribution, legislation was passed to form the National Health Service Corps (NHSC, www.bphc.hrsa.gov/nhsc/) and Critical Health Manpower Shortage Areas (CHMSA) to identify areas with fewer than one physician for every 4,000 residents. CHMSA evolved into HPSA, Health Professional Shortage Areas (Figure 9). In 1978 the designation requirement for HPSA was fewer than one primary care physician to 3,500 residents, and in areas with unusually high service needs, a ratio of 1 to 3,000.[55]

Federal Telemedicine Projects

Various agencies and departments of the federal government have funded telemedicine as a way to bring health care services to medically underserved populations.

[53] Pearson and Lewis, 956.

[54] Ibid., 956.

[55] Council on Graduate Medical Education, 2.

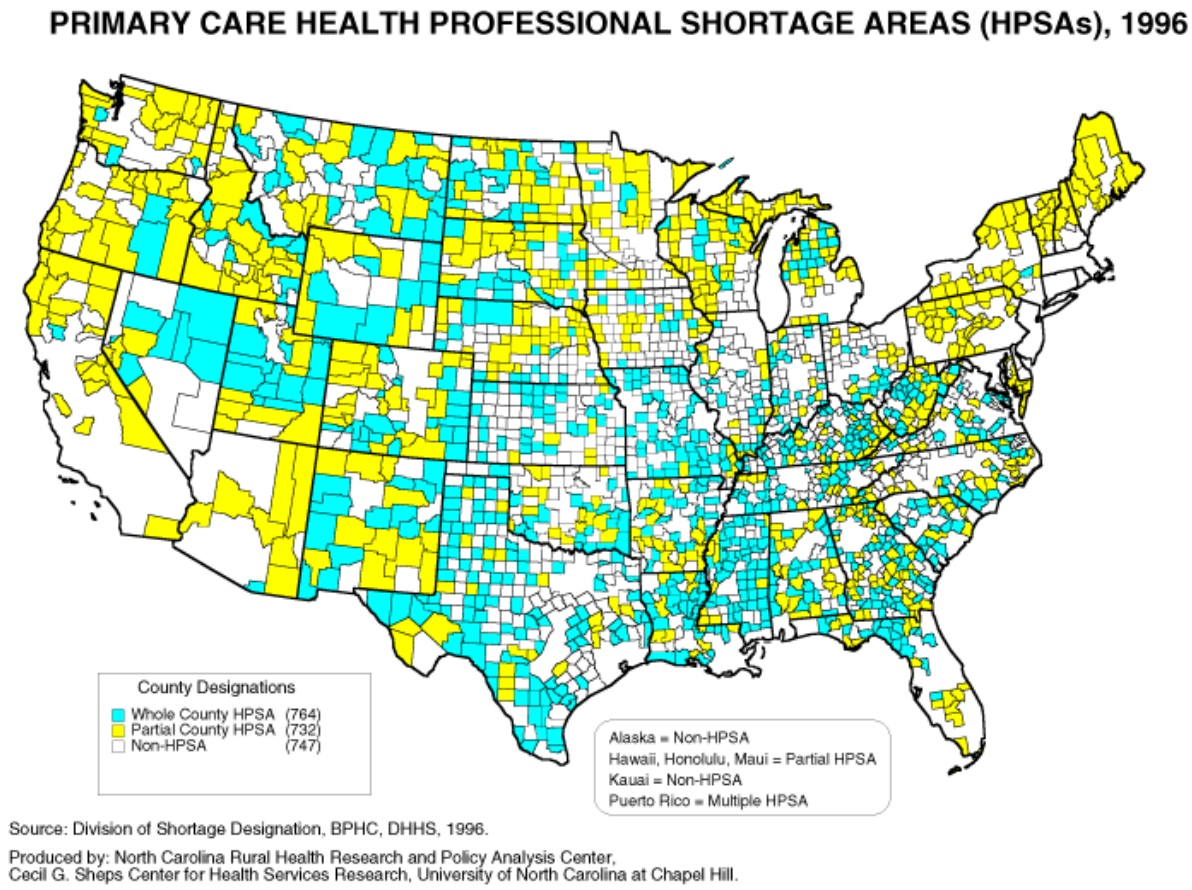
PRIMARY CARE HEALTH PROFESSIONAL SHORTAGE AREAS (HPSAs), 1996
County Designations
Whole County HPSA (764)
Partial County HPSA (732)
Non-HPSA (747)
Alaska = Non-HPSA
Hawaii, Honolulu, Maui = Partial HPSA
Kauai = Non-HPSA
Puerto Rico = Multiple HPSA
Source: Division of Shortage Designation, BPHC, DHHS, 1996.
Produced by: North Carolina Rural Health Research and Policy Analysis Center,
Cecil G. Sheps Center for Health Services Research, University of North Carolina at Chapel Hill.

Figure 9.
Primary Care HPSAs (Health Professional Shortage Areas), 1996[56]

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[56] North Carolina Rural Health and Research and Policy Analysis Center, Cecil G. Sheps Center for Health Services Research, University of North Carolina at Chapel Hill, "Primary Care Health Professional Shortage Areas (HPSAs), 1996." Available at www.shepscenter.unc.edu/research_programs/Rural_Program/maps/hpsa96n.html.

In 1998, the Health Resources and Services Administration established OAT, the Office for the Advancement of Telehealth, for the purpose of supporting "telecommunications for technical assistance, training, and knowledge exchange among grantees, clinicians and other health care professionals, especially those providing services to low-income, medically underserved or isolated Americans."[57]

Other federal departments and agencies that support telemedicine initiatives include:

- National Aeronautics and Space Administration
- Department of Agriculture
    - Rural Utilities Service
- Department of Commerce
    - Technology Opportunities Program
    - Department of Defense, National Telecommunications Information Administration
- Department of Health and Human Services
    - Office of Rural Health Policy
    - Health Care Financing Administration
    - National Institutes of Health
    - National Institute of Mental Health
    - National Institute on Disability and Rehabilitation Research
    - National Library of Medicine
    - Agency for Health Care Policy and Research

[57] Health Resources and Services Administration, United States Department of Health and Human Services, "HRSA Focuses Agency Resources on Telehealth," *HRSA News* (May 22, 1998). Available at http://newsroom.hrsa.gov/releases/oat.htm

Federal funding for telemedicine, over $100 million each year since 1995,[58] supports an array of telemedicine projects. The *1999 Report on U.S. Telemedicine Activity* lists four types of federal support for telemedicine:

1. Direct funding of federal programs, such as the Veterans' Administration, Department of Defense, and Federal Bureau of Prisons;
2. Grants and awards for telemedicine projects by the Office for the Advancement of Telehealth, Rural Utilities Service, National Library of Medicine, and National Telecommunications Information Administration;
3. Awards and contracts for applied research, such as Health Care Financing Administration studies, National Institute of Mental Health grants;
4. Funding of specific initiatives, such as the Universal Services

Adoption of Telemedicine Technology

An analysis of the recent research literature on the effect of telemedicine on doctor-patient communication identified thirty-eight studies: six surveys of healthcare providers and community attitudes, twenty-one post telemedicine encounter surveys, and eleven qualitative encounter behavioral studies.[59]

Abstracted research findings were coded positively or negatively into twenty-three categories: communication efficacy; patient-provider relations, rapport development; patient and provider question-asking; patient and provider understanding;

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[58] Perednia and Allen, 483; Nesbitt, Ellis and Kuenneth, S2:21; Grigsby and Brown, 11,13.

[59] Edward A. Miller, "Telemedicine and Doctor-Patient Communication: An Analytical Survey of the Literature," *Journal of Telemedicine and Telecare* 7 (2001), 1-17.

patient and provider explanation; patient and provider comfort; embarrassment, anxiety, audio and video quality, non-verbal behavior, lack of touch, self-viewing on screen, multiple providers, patient involvement, privacy, encounter length, and miscellaneous effect. The findings were 80 percent favorable to telemedicine in general, and predominately favorable in all but two of the twenty-three categories, non-verbal behavior and lack of touch.[60]

Patient Acceptance

A review of 32 studies of clinical patients' satisfaction with telemedical encounters reports that patients generally are satisfied with telemedicine as a health delivery system.[61]

A recent study of rural East Tennessee tele-homecare patients reported the results of patient surveys and interviews that indicate a high degree of patient acceptance. More than 80 percent rated the tele-homecare visit to be comfortable. More than 90 percent of patients believed the quality of the tele-homecare visit to be as good as or better than a traditional nurses' visit.[62] In-depth interviews of nine patients and caregivers identified perceptions of perceived benefits and disadvantages of tele-homecare delivered through

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[60] Ibid., 12-15.

[61] Frances Mair and Pamela Whitten, "Systematic Review of Studies of Patient Satisfaction with Telemedicine," *British Medical Journal* 320 (June 3, 2000), 1517-20.

Dena S. Puskin, et al., "Patient and Provider Acceptance of Telemedicine," *New Medicine* (Philadelphia: Current Science, Inc., 1997), 55-59.

[62] Dimmick et al., 131.

interactive audio-video (video camera, video monitor, speaker-phone, and electronic interface to standard telephone line):

- The telemedicine equipment was easy for them to use
- Increased, faster access to "just in time" healthcare advice
- Increased sense of security and reduced anxiety with medical help a videophone call away
- Reduced pain exacerbated by travel to the doctor or clinic
- Transportation time and cost savings
- More convenient than an in-home visit
- Didn't have to drive on dangerous rural roads, especially at night or during bad weather
- Reduced confusion over medication, diet, and other instructions
- Increased personal attention from medical staff
- Added value of visualization of a problem, such as a wound
- Increased sense of privacy
- Increased sense of being in control.[63]

Some of the disadvantages of the tele-homecare visit include occasional technical problems with the equipment or phone lines. Two of the nine patients interviewed reported missing their lung sounds or blood pressure taken by an in-home nurse.

[63] Ibid., 130.

Provider Acceptance

While the level of patient acceptance of telemedicine is generally high, provider acceptance is somewhat lower. Grigsby asserts that physician reluctance to adopt telemedicine is attitudinal and may reflect such issues as political philosophy, lack of behavioral and financial incentives, and the perception of telemedicine as a threat.[64]

An investigation of physician acceptance of telemedicine found that telemedicine adopters had much greater interest in using the technology routinely than non-adopters. Survey data support the Theory of Planned Behavior, which states that a behavior can be explained in large degree by the intention to do that behavior.[65]

A survey of Hong Kong physicians found a difference by specialty in intention to use telemedicine. Clinicians with multiple specialties expressed a significantly stronger intention to use telemedicine than single-specialty clinicians. Of the single-specialty clinicians, neurosurgeons and emergency physicians expressed the strongest intention to use telemedicine in the future.[66]

In the same study, researchers also found variation in the degree of actual telemedicine technology adoption by physician specialty. Radiologists, pathologists and surgeons are the most frequent adopters and family practitioners the least.[67]

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[64] Jim Grigsby, "Current Status of Domestic Telemedicine," *Journal of Medical Systems* 19 (1995), 25.

[65] Paul Jen-Hwa Hu and Patrick Yam-Keung Chau, "Physician Acceptance of Telemedicine Technology: An Empirical Investigation," *Topics in Health Information Management* 19 (1999), 32.

[66] Olivia R. Liu Sheng, et al., "A survey of Physicians' Acceptance of Telemedicine," *Journal of Telemedicine and Telecare* 4 (1998), 102.

[67] Hu and Chau, 30.

A study of primary care physicians in rural Kansas reported that the only practice characteristic significantly related to the use of telemedicine was referral pattern. While three of seventeen non-users of telemedicine occasionally referred patients to specialists at the University of Kansas Medical Center, three of nine users of telemedicine routinely referred patients to UKMC specialists (17.6% versus 33.3%). The authors of this study suggest a strong outreach program that promotes referrals to the hub site could increase the use of telemedicine.[68]

The Internet and E-Mail

The acceptance and use of the Internet and e-mail for medical consultations reflect the acceptance patterns of telemedicine in general, that is acceptance by the majority of healthcare consumers, and less acceptance by healthcare providers.

A survey of oncology patients by Katzen and Dicker found that 72 percent felt comfortable corresponding with their doctor via e-mail for minor health problems in non-urgent situations. Even those patients not currently using e-mail responded favorably to the idea of corresponding with their doctor or his staff using e-mail.[69]

A survey of 209 unsolicited e-mails from dermatology patients to healthcare providers found that 81 percent of patients seeking tele-advice suffered from a chronic

[68] Pamela Whitten and E.A. Franken, "Telemedicine for Patient Consultation: Factors Affecting Use by Rural Primary-Care Physicians in Kansas," *Journal of Telemedicine and Telecare* 1(1995), 142, 143.

[69] C.S. Katzen and A.P. Dicker, "A Survey to Evaluate Patients' Perspective Concerning E-mail in an Oncology Practice," *International Journal of Radiation Oncology* Biology* Physics* 51 (November 2001), 101.

disease. According to the authors' evaluation, only 28 percent were suitable questions to be answered by healthcare professionals via e-mail. About 40 percent could have been answered by a librarian. The authors concluded that while tele-advice via e-mail may be overused by chronically ill and frustrated patients, e-mail communication could substitute for an office visit in some cases.[70]

A Harris Interactive survey reports that about 90 percent of respondents would like to contact their physician online and about 40 percent would be willing to pay for such a service. Seventy-seven percent would like to ask medical questions, 71 percent to schedule appointments, 71 percent to request prescription renewals, and 70 percent to receive medical test results.[71]

A Harris Interactive survey of 834 physicians found that about 55 percent use e-mail to communicate with professional colleagues, 34 percent e-mail support staff, but only 13 percent use e-mail to communicate with patients.[72]

According to a survey by Fulcrum Analytics and Deloitte Research, physician concerns about e-mail include reimbursement, privacy of patient information, and potential malpractice liability.[73]

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[70] Gunther Eysenbach and Thomas L. Diepgen, "Patients Looking for Information on the Internet and Seeking Teleadvice: Motivation, Expectations, and Misconceptions as Expressed in E-mails Sent to Physicians," *Archives of Dermatology* 135 (February 1999), 151-156.

[71] Humphrey Taylor and Robert Leitman, eds., "Patient/Physician Online Communication: Many Patients Want It, Would Pay For It, and It Would Influence Their Choice of Doctors and Health Plans," Harris Interactive *Health Care* News 2 (April 10, 2002). Available at: http://www.harrisinteractive.com/news/newsletters/healthnews/HI_HealthCareNews2002Vol2_Iss08.pdf

[72] Humphrey Taylor and Robert Leitman, eds., "New Data Show Internet, Web Site and E-mail Usage by Physicians All Increasing," Harris Interactive *Health Care* News 1 (February 26, 2001). Available at: http://www.harrisinteractive.com/news/newsletters/healthnews/HI_HealthCareNews2001Vol1_iss8.pdf

Spielberg suggests that physicians should be aware of liability issues and should preserve patient privacy and confidentiality by encrypting e-mail messages.[74]

Five agendas to shape patient-physician electronic communications have been identified by Mandi et al.:

1. Definition of appropriate use
2. Security and confidentiality
3. Effective interfaces with user guidance
4. Proactive assessment of medical liability
5. Widespread, multicultural access.[75]

The American Medical Informatics Association (AMIA) has published a white paper, "Guidelines for the Clinical Use of Electronic Mail with Patients." Guidelines include:

- Establish turnaround time
- Do not use e-mail for urgent matters
- Inform patient that e-mail message will be part of medical record

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[73]Fulcrum Analytics and Deloitte Research, "Taking Technology's Temperature: Physicians Still Cool Toward E-mail." Available at http://www.fulcrumanalytics.com/news/releases/2002/01-29-ful-takingthepulse.html

[74] Alissa R. Spielberg, "On Call and Online: Sociohistorical, Legal, and Ethical Implications of E-mail for the Patient-Physician Relationship, *Journal of the American Medical Association* 280 (October 21, 1998), 1353-1359.

[75] Kenneth D. Mandi, Isaac S. Kohand, and Allan M. Brandt, "Electronic Patient-Physician Communication: Problems and Promise," *Annals of Internal Medicine* 15 (September 1998), 495-500.

- Establish types of e-mail transactions permitted, such as prescription refill, scheduling appointments, etc.
- Instruct patients to put transaction category in e-mail subject line
- Instruct patients to put name and patient ID number in message
- Send auto-reply confirming receipt of patient message
- Reply to inform patient of completion of request
- Instruct patients to use auto-reply confirming receipt of provider message
- Maintain patient e-mailing list, but use blind copy feature to send batch e-mails
- Avoid negative emotions such as anger, sarcasm, criticism toward patient or third party
- Place print copy of e-correspondence in patient chart.[76]

Telemedicine Theory

Cybernetic Model

A simplified cybernetic healthcare model has been proposed by Cramp and Carson as an effort toward quantifying healthcare and its effectiveness and maximizing the value of telecare (Figure 10). The three main components of the model are healthcare

[76] Beverley Kane and Daniel Z. Sands, "Guidelines for the Clinical Use of Electronic Mail with Patients," *Journal of the American Medical Informatics Association* 5 (Jan/Feb 1998), 104-111. Available at: http://www.amia.org/pubs/other/email_guidelines.html

management (decision-makers), healthcare service provision, and the target population, with information systems supporting management and providing a feedback loop.[77]

This model is useful in that it visualizes the role of technology in the support and delivery of healthcare. The feedback loop also hints at changes in clinical research that telemedicine could provide.

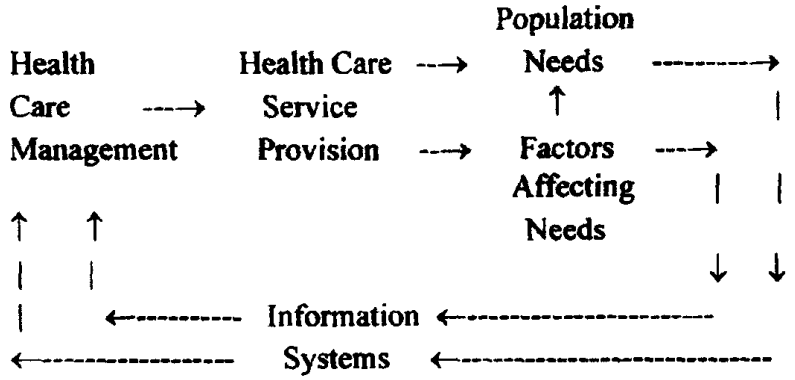

Figure 10.
Cramp and Carson's Simplified Conceptual Healthcare Model[78]

[77] Derek G. Cramp and Ewart R. Carson, "A Model-Based Framework for Public Health A Vehicle for Maximising the Value of Telecare?" S Laxminarayan, ed., *Proceedings of the 3rd IEEE EMBS International Conference on Information Technology Applications in Biomedicine (ITAB 2000),* Piscataway, NJ: IEEE, 2000, 272-277.

According to Bauer and Ringel, telemedicine can not only facilitate research, it "will cause radical changes in the scientific definition of what 'works' in medicine."[79]

They foresee that research is likely to be changed by telemedicine in several ways. The creation of networked databases encompassing an entire population of comparable patients will reduce or eliminate the need for random sampling and statistical analysis, and may drastically reduce the time and costs it currently requires to analyze data and translate the findings into practice.[80]

They also foresee an overall improvement in quality of research data since "standardized data collection methods can be built into the computerized interfaces between clinicians and patients"[81] This type of electronic data collection has the

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[78] Crook and Carson, 275.

[79] Bauer and Ringel, 94-97.

[80] Ibid., 94-95.

[81] Ibid., 95.

potential to eliminate biases, embed research protocols, and reinforce experimental controls.[82]

Cramp and Carson also propose a more complex cybernetic digraph of public healthcare that includes more detail of the factors influencing healthcare. More details about the factors affecting healthcare are included, as well as causal connectivity and direction of change (Figure 11).

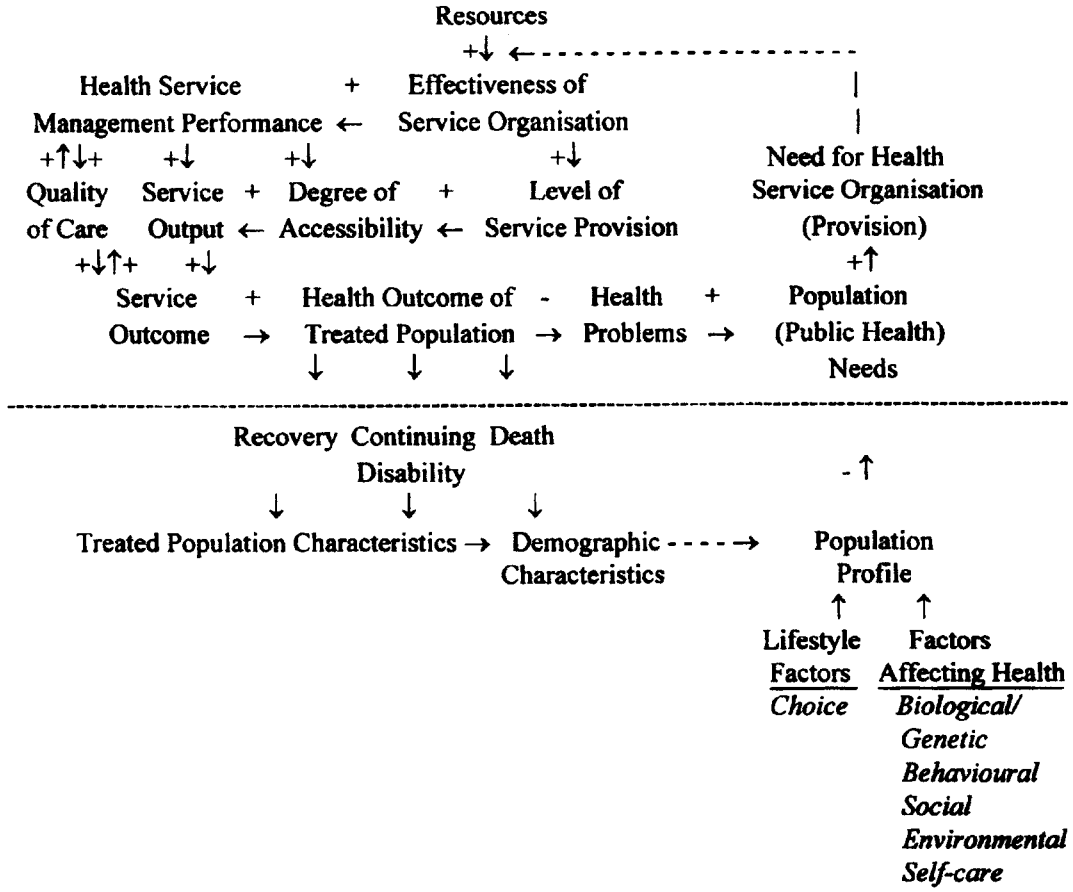

Figure 11.
Cramp and Carson's Public Healthcare Digraph[83]

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[82] Ibid., 96.

The upper portion of the digraph "shows the population needs driven loops giving rise to changes in service organization and provision, highlighting the relationships with health service management performance, degree of accessibility to the services offered, and hence service output and service outcome. This in turn impacts upon the health outcome of the treated population, with improvement at this juncture leading to reduced health problems …."[84]

The lower portion of the model details population profile factors as a "driver and determinant" of healthcare needs.[85]

Diffusion of Innovations

A prototype for the Diffusion of Innovations Model can be found in *The Laws of Imitation*, written by French sociologist Gabriel Tarde in 1890, and first translated into English in 1903. He noted the influential diffusion concept of opinion leadership and observed the distinctive S-curve pattern of innovation adoption.[86]

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[83] Ibid., 275.

[84] Ibid., 274.

[85] Ibid., 274.

[86] Paul Marsden, "Forefathers of Memetics: Gabriel Tarde and the Laws of Imitation," *Journal of Memetics - Evolutionary Models of Information Transmission* 4 (2000). Available at: http://www.cpm.mmu.ac.uk/jom-emit/2000/vol4/marsden_p.html.

Everett Rogers, the name most associated with diffusion of innovations research, defines *diffusion* as "the process by which an innovation is communicated through certain channels over time among the members of a social system.[87]

Rogers developed a five-stage model that could be used in both an individual and an organizational research level (Figure 12). His model of diffusion consists of *knowledge*, or awareness of the innovation; *persuasion*, in which an opinion is formed about the innovation; *decision* to adopt the innovation or not; *implementation*, if so decided; and *confirmation* of the innovation.[88]

According to a more detailed Diffusion of Innovations Model (Appendix 3), prior conditions that may affect the model include previous practice, felt needs and/or problems, innovativeness, and social system norms.[89]

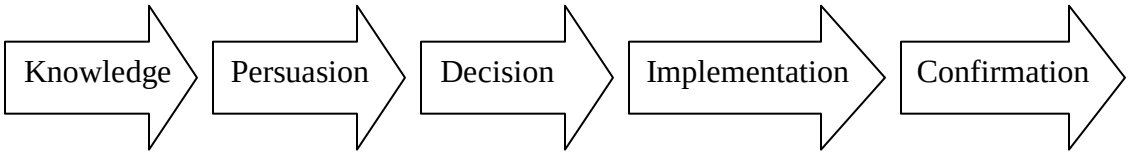

Figure 12.
Roger's Diffusion of Innovation Stages[90]

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[87] Everett Rogers, *Diffusion of Innovations,* Fourth edition (New York: The Free Press, 1995), 5.

[88] Ibid., 10-11.

[89] Ibid., 165.

[90] Ibid., 10-11.

Characteristics of the decision-making unit that may influence knowledge include socio-economic characteristics, personality variables, and communication behavior.[91]

Rogers enumerated some perceived characteristics of innovations that may influence persuasion and may help to explain different rates of adoption:

1. Perceived relative advantage
2. Compatibility with values and needs of adopters
3. Perceived complexity of use
4. Trialability
5. Observability, visibility.[92]

Elements in the more complex diffusion model (Appendix 3) are connected by communication channels that provide interactivity and a feedback loop similar to the cybernetic model (see Figure 10).

At the individual level, Rogers calls those within the organization who have the ability to influence others *opinion leaders*. Opinion leaders usually are social models and are more cosmopolitan, more innovative, of higher social status and exposed to more external communication than their coworkers.[93]

A related factor that may influence adoption of innovation is membership in professional associations. The role of professional associations in diffusion was examined

[91] Ibid., 165.

[92] Ibid., 14-16, 165.

[93] Ibid., 28.

by Swan and Newell. A survey of professional association members indicated perceptions that the association was an important network for learning about new research and development and in imparting knowledge important for the diffusion of new technology. Predictors of diffusion include involvement in the association's professional development activities, their firm's size, and degree of internal-communication within their firms.[94]

In addition, rate of adoption may be influenced by organizational structure, such as what Rogers calls *"system effects*, the influences of the structure and/or composition of a system on the behavior of the member of the system,"[95] that is, whether the organizational culture tends to be conducive to innovation, early adopters, early majority, late majority or laggards [96]

Rogers claims that, generally, "innovations that are perceived by receivers as having greater relative advantage, compatibility, trialability, observability, and less complexity will be adopted more rapidly than other innovations" and "are the most important characteristics of innovations in explaining rate of adoption."[97]

Diffusion of Innovations in Health Care Organizations

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[94] Jacky A. Swan and Sue Newell, "The Role of Professional Associations in Technology Diffusion," *Organization Studies* 16 (Winter 1995), 847-875.

[95] Rogers, 25.

[96] Ibid., 22.

A longitudinal study (over ten years) of more than four hundred California hospitals found a strong relationship between inter-organizational links and innovation adoption. Research methods included interviews with hospital and network executives, mailed surveys, publications and industry reports and data. The authors, Goes and Park, concluded, "hospitals that linked into multi-hospital systems, regularly exchanged resources with related hospitals, and aggressively built institutional affiliations were more likely to adopt innovative services and technologies."[98]

A study of the diffusion of telemedicine in North Carolina hospitals suggests three characteristics of hospitals that adopt telemedicine:

1. They are larger, metropolitan hospitals
2. They are part of integrated delivery networks (IDNs)
3. They are not-for-profit organizations[99]

An examination of the adoption of MRI technology (magnetic resonance imaging) in California, Oregon, and Washington hospitals focused on the relative roles of decision-makers and environmental turbulence on technology adoption rates. The survey, targeting administrative officers, found that physician and executive officer advocacy was strongly

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[97] Ibid., 16.

[98] James B. Goes and Seung Ho Park, "Interorganizational Links and Innovation: The Case of Hospital Services," *Academy of Management Journal* 4 (June 1997), 684-87.

[99] Sherry Emery, "The Diffusion of Telemedicine in the Southeastern United States: A Rural-Urban Perspective," Cecil G. Sheps Center for Health Service Research, University of North Carolina at Chapel Hill,Chapel Hill, NC (June 1996).

related to early adoption of MRI technology in less turbulent hospital environments (Oregon and Washington), but not in California. In the more volatile California hospitals, hospital executives viewed the acquisition of new technology as a way of controlling environmental turbulence.[100]

Critical Mass Theory

Markus expanded upon the Diffusion of Innovations Theory and the Critical Mass Theory to develop a "critical mass explanation for the diffusion of interactive media, such as telephone, paper mail systems, electronic mail, voice messaging, or computer conferencing within communities".[101]

Oliver et al. defined *critical mass* (a term borrowed from physics meaning the amount of radioactive material required to produce a nuclear reaction) as a "small segment of the population that chooses to make big contributions to the collective action, while the majority do little or nothing."[102]

In her studies of interactive media, Marcus describes an "accelerating production function" in that the greater the number of users of an interactive technology, the more

[100] Leonard H. Friedman and James B. Goes, "The Timing of Medical Technology Acquisition: Strategic Decision Making in Turbulent Environments," *Journal of Healthcare Management* 45 (September 2000), 317-331.

[101] M. Lynne Markus, "Toward a Critical Mass Theory of Interactive Media: Universal Access, Interdependence, and Diffusion," *Communication Research* 14 (1987), 491.

[102] Pamela Oliver, Gerald Marwell, and Ruy Teixeira, "A Theory of the Critical Mass. I. Interdependence, Group Heterogeneity, and the Production of Collective Action," *American Journal of Sociology* 91 (November 1985), 522-556.

value it has to the larger group. Widespread use leads to a maximum value of universal access.[103]

Marcus replaces the Diffusion of Innovation's assumption of *sequential interdependence*, in which later adopters are influenced by early adopters, with Thompson's concept of *reciprocal interdependence*, "in which early adopters are influenced by later ones or non-adopters as well as vice versa."[104]

Early adopters of new interactive media experience relatively low benefits and higher costs, but if use of a new medium becomes more widespread, costs drop, benefits increase, and adoption within the general population is accelerated. "But if early users are not reinforced by reciprocity from communication partners, they are very likely to discontinue using the medium."[105]

Case Studies, Surveys of Telemedicine Networks

A case study of a hospital in West Texas investigated the adoption of telemedicine as an attempt by one rural hospital to remain viable and competitive within the local community. The research method used was the examination of local media

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[103] Markus, 491.

[104] J.D. Thompson. *Organizations in Action* (New York: McGraw-Hill, 1967) quoted by Marcus, 494.

[105] R.E. Rice, "Communication Networking in Computer-Conferencing Systems: A Longitudinal Study of Group Roles and System Structure," M. Burgoon, ed., *Communication Yearbook* 6 (Newbury Park, CA: Sage, 1982), 925-944. Quoted by Marcus, 495.

coverage of Texas Tech Health Sciences Center and its participation in the MEDNET telemedicine project.[106]

Media reports were collected in three different time periods: 1980-87, the pre-MEDNET years; 1988-92, the MEDNET years; and 1993-97, the Healthnet years. Findings of the study include:

- Telemedicine technology was successful in providing educational and medical support to the hospital staff
- The telemedicine network forged new links between the hospital, the local university and area public school.
- Telemedicine links to rural clinics provided healthcare access to underserved communities
- The ability of telemedicine to increase the viability of the hospital, however, was limited by a history of hospital financial problems and conflicts that undermined community trust.[107]

A review of cast studies in tele-psychiatry concluded that even low-cost POTS (plain old telephone system) video-phone consultations created a valuable connection between specialists in academic centers and patients with a local healthcare provider (doctor, nurse-practitioner or nurse) in rural areas. The principle value of the visual

[106] Dianne Sykes and William Alex McIntosh, "Telemedicine, Hospital Viability, and Community Embeddedness: A Case Study," *Journal of Healthcare Management* 44 (Jan/Feb 1999), 59-71.

[107] Ibid., 69-71.

element seems to be in creating a social presence, or tele-presence, with visual, interpersonal cues, such as eye contact, nods, facial expressions, and body language.[108]

A case study of the University of Kansas Telemedicine Program found that organizational communication and structure may be critical to the successful adoption of telemedicine technology. Recommendations that were adopted as a result of this study include: a definition of employee roles and responsibilities, simplification of consultation scheduling, clarification of leadership and decision-making, and clarification of telemedicine terminology.[109]

An investigation of whether and how telemedicine affects hospital costs was based on surveys and interviews with hospital administrators in North Carolina, South Carolina, and Georgia. Objectives of the research included: the identification of hospital characteristics that are related to adopting telemedicine technology and the identification of derived benefits from their adoption of telemedicine.[110]

Quantitative survey research data indicate that several factors independently increase the odds of the adoption of telemedicine by hospitals: not-for-profit status, a multi-hospital and/or network affiliation, and size (large number of hospital beds).[111]

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[108] Peter Cukor et al., "Use of Videophones and Low-Cost Standard Telephone Lines to Provide a Social Presence in Telepsychiatry," *Telemedicine Journal* 4 (1998), 313.

[109] Pamela S. Whitten and Ace Allen, "Analysis of Telemedicine from an Organizational Perspective," *Telemedicine Journal* 1 (1995), 203-213.

[110] Sherry Emery, *Telemedicine in Hospitals: Issues in Implementation*, Health Care Policy in the United States, ed. John G. Bruhn (New York: Garland Publishing, 1998), 116.

[111] Ibid., 116.

Qualitative survey and interview research data suggest that hospital administrators adopt telemedicine as a competitive strategy and as a managed care strategy.[112]

[112] Ibid., 117.

CHAPTER III

METHODOLOGY

Case Study

Case study is a methodology that involves collecting evidence from multiple sources. Yin notes that case studies should use a broad variety of techniques - surveys, archive analyses, documentary searches, field observations, even quantitative data, "In fact, the more all of these techniques are used in the same study, the stronger the case study evidence will be."[113]

Case study methodology is considered most appropriate when "a 'how' or 'why' question is being asked about a contemporary set of events over which the investigator has little or no control."[114]

The specific research methods used in these case studies include in-depth interviews with key informants, coding interview transcripts with NUD*IST qualitative software, triangulation of interview data with published reports and archival data, and qualitative data analysis.

Research Design

[113] Robert K. Yin, "Enhancing the Quality of Case Studies in Health Services Research," *Health Services Research* 34 (December 1999), 1214.

[114] Robert K. Yin, *Case Study Research: Design and Methods*. Fourth edition. (Thousand Oaks: Sage Publications, 1994), 9.

The quality of research design is based on such concepts as trustworthiness, credibility, confirmability, and data dependability.[115] In case study research, these concepts are addressed by specific tactics to assure construct validity and reliability.[116]

Construct validity is defined by Yin as, "establishing correct operational measures for the concepts being studied."[117] In this multiple case study, construct validity was assured by triangulating, or cross-checking, with multiple sources of evidence and by having the key informants review a draft analysis of their interview. No major changes were necessary, but minor changes and additions for clarification were suggested by the key informants and incorporated into the analysis. To assure accuracy, all of the data were cross-checked with other sources including official Web sites, research publications, and federal grant progress reports from the Office for the Advancement of Telehealth obtained through a Freedom of Information Act request.

Reliability is defined by Yin as, "demonstrating that the operations of a study, such as the data collections procedures, can be repeated, with the same results."[118] Reliability was assured in this multiple case study by pilot case study research, by following case study protocol and by developing a case study database.

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[115] U.S General Accounting Office, Program Evaluation and Methodology Division, *Case Study Evaluations.* (Washington, D.C: Government Printing Office, 1990).

[116] Yin, 1994, 33

[117] Ibid., 33.

[118] Yin, 1994, 33.

Pilot case study research was conducted at the University of Tennessee Telemedicine Network (recently renamed the University of Tennessee Telehealth Network). Some of the research data contributed to the publication, "A Case Study of Benefits and Potential Savings in Rural Home Telemedicine."[119] Interviews and surveys conducted in the pilot case study research were instrumental in the development and refinement of the survey instrument used in this study.

According to Yin, case study protocol should include:

- An overview of the project, its purpose, objectives, case study issues and a literature review of relevant readings
- Field procedures and sources of information
- Case study questions, including specific survey instrument, if applicable
- A guide, or outline, for the case study report.[120]

Case study protocol outlined by Yin was used as a model and followed during the course of this research study. A project database was developed using multiple formats. Separate electronic and print folders for each of the eight cases studied contain documents related to that particular case study, including interview transcripts, research publications, and correspondence with key informants. A NUD*IST qualitative

[119] Dimmick, et al., February 2000.

[120] Yin, 1994, 64, 65.

software project database contains all of the interview transcripts, the coding protocol, and the coding for each node within the protocol.

A survey instrument was developed to guide the key informant interviews and to use as a prototype for future studies (Appendix 2). Key informants from each case study were furnished the survey instrument in advance to prepare them for the interview and to allow them to assemble the requested documents, such as an organizational chart.

Written and oral permissions were obtained from the key informants to audio-tape the interviews. Interviews were conducted in person, by telephone, or, by videophone using telemedicine technology at the University of Tennessee Telehealth Network.

Interviews were transcribed verbatim, and the ninety-seven transcribed pages were coded using the qualitative analysis software, NUD*IST N4. The data was triangulated by cross-checking with other authoritative sources including:

- Case study's Web sites and marketing publications
- Federal OAT grant progress reports
- Telemedicine Information Exchange online database
- Research publications.

Results from each telemedicine program were compiled, analyzed and compared for similarities and differences among different types of telemedicine networks in:

1. Organizational structure, type and level of staffing
2. Kinds of human resources, their roles and necessary capabilities

3. Organizational problems and barriers of building, maintaining, and sustaining a telemedicine network
4. Organizational structure most conductive for a successful telemedicine network.

Unit of Study - Telemedicine Network

Operational Definition

Operationally defining the case or cases to be examined is perhaps the most difficult but important step in case study research. Without a clear and precise definition, there is danger that the findings may not be applicable to the original case, and in multiple case studies, findings may not be comparable.[121]

For example, is a telemedicine network or system defined by a geographical area, by the technology, by the healthcare provider, by the actual clients or by a set of eligible clients?

A telemedicine network is generally defined by geography and technology. In Figure 13, The University of Tennessee Telemedicine Network, the hub site is connected to the spoke sites by T-1 lines (dedicated phone connections that support data transmission rates of 1.544 Mbits per second), ISDN lines (integrated services digital network), and POTS (plain old telephone system).

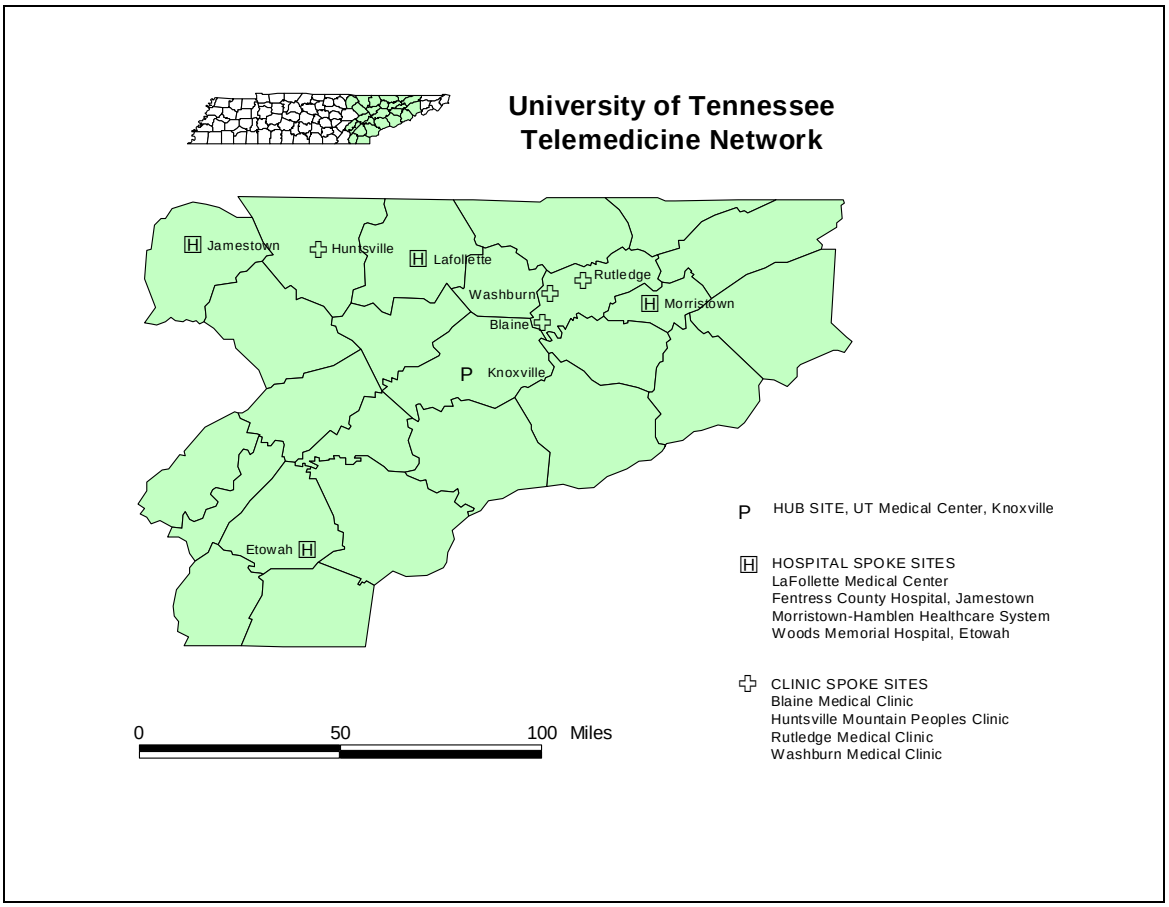


Figure 13.
Telemedicine Network (2000), Geographic Model

[121] Ibid.

The hub site is typically in a large, regional hospital or medical center, although it could be located in a specialist's office or in a specialty department, such as a regional trauma center. The spoke sites are located in a wide variety of settings including smaller community hospitals or clinics, schools or other community buildings, health care professional offices, nursing homes, prisons, private residences, or in mobile units in ambulances, helicopters, airplanes, or ships.

For the purposes of this study, a telemedicine network is defined primarily by the healthcare providers, the healthcare clients, and the persons who assist in their virtual encounter (proposed Telemedicine Clinical Network Model, Figure 14). Although it plays an important role, the technology is merely the conduit that makes the virtual encounter possible.

The hub site specialist(s) could be a physician specialist, nurse practitioner specialist, nurse specialist, allied health care specialist (therapist, nutritionist, etc.), and/or medical education or training specialist.

The healthcare client is typically a patient accompanied by a presenter, usually a nurse or another healthcare professional, or the patient and/or caregiver in a home-health setting. Healthcare clients may also be a student or another healthcare professional.

The interactive encounter, symbolized by the two-way arrow, could be a patient consultation with medical specialist(s), a consultation between healthcare professionals, a continuing medical education or training session, or public health education session.

The encounters could also include tele-homecare and/or tele-monitoring by a homecare nurse and transmission of digital data.

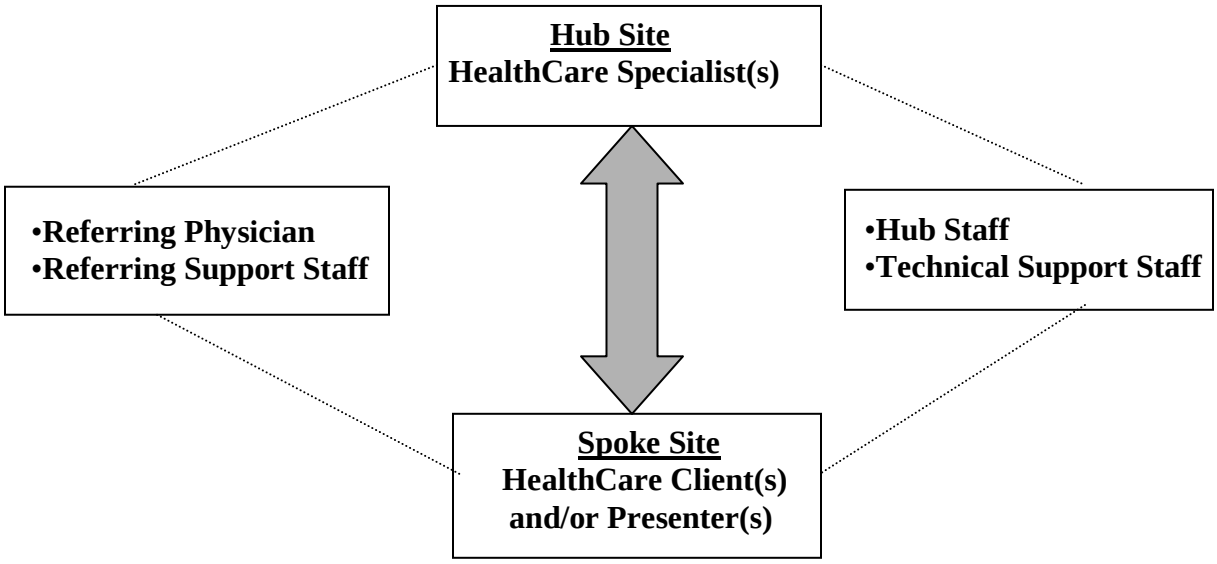


Figure 14.
Telemedicine Network, Clinical Model

Case Selection Criteria

Yin recommends a logical selection of case studies, instead of sampling, because typically, case study research involves in-depth study of a small number of specific types of cases chosen to address specific questions of "how" and "why."

For this study, two cases were selected from each of four types of telemedicine/telehealth organizations: academic medical centers, non-academic medical centers or networks, statewide telemedicine networks, and telemedicine programs located within a health insurance company.

Selection criteria include length of time in operation (at least three years), geographic diversity, and quantity and availability of published documentation associated with the telemedicine network determined by bibliographic analysis.

The two key informants from telemedicine programs located within health insurance companies were reluctant to have their corporate identities revealed, in part because of corporate proprietary information, so they will be identified as Insurer-based One and Insurer-based Two.

Selected Cases

Academic Medical Centers

1) Arizona Telemedicine Program

1501 N. Campbell, Tucson, AZ 85724-5105

2) East Carolina University Telemedicine Program

1S-10 Brody Bldg., Greenville, NC 27858

Non-Academic Medical Centers or Networks

3) Eastern Montana Telemedicine Network

PO Box 37000, Billings, MT 59107

4) Marshfield Clinic TeleHealth Network

1000 N. Oak Avenue, Marshfield, WI 54449

Statewide Telemedicine Networks

5) Center for TeleMedicine and TeleHealth

The University of Kansas Medical Center

3901 Rainbow Blvd, 2012 Wahl Annex Bldg., Kansas City, KS 66160

6) Missouri Telehealth Network

2401 Lemone Industrial Blvd. DC 345.00

Columbia, MO 65212

CHAPTER IV

RESULTS

Introduction

General information about each program was obtained from the programs' Web sites, research publications, Telemedicine Information Exchange Database and the Office for the Advancement of Telehealth Grantees Directory.[122]

The telemedicine programs' mission statements, goals, and/or objectives were obtained from the organizations' Web sites or other official publications. In some cases, the mission, goals, and/or objectives were specific to telemedicine. In other cases, the telemedicine program followed the mission of the parent organization. For consistency, the parent organizations' mission statements are included.

To insure accuracy of the transcripts, interview transcriptions and the results of the interview analyses were sent to the key informants for review. No major changes were needed, but many minor changes or additions for clarification were suggested by the key informants. Data from the interview analyses were then triangulated and cross-checked for accuracy using organizational publications, research reports, and federal grant progress reports obtained through the Freedom of Information Act.

[122] Office for the Advancement of Telehealth, "OAT Grantee Directory: FY 2000," U.S. Department of Health and Human Services, Health Resources and Services Administration (2000), 13.

Mission Statement, Goals, Objectives

Academic Medical Systems

Arizona (Sites, Figure 15)

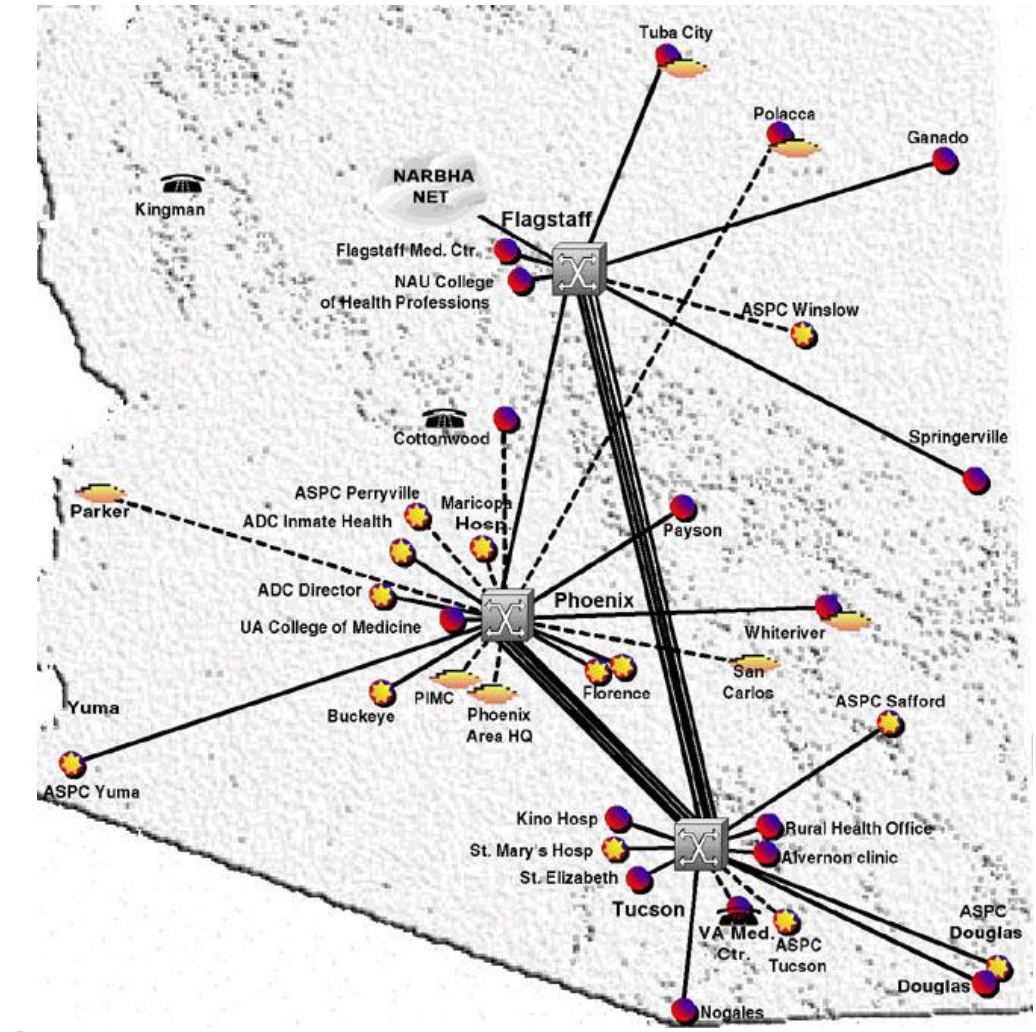
> The Arizona Telemedicine Program uses interactive and store and forward technologies to connect 28 sites within Arizona. Of the 14 full service sites, seven are in health professional shortage areas and six are Department of Corrections sites…. service area includes the Hopi, Navajo, and Apache Nations. The network has been operational since May of 1997.
>
> The network plans to expand services to all state correctional facilities. The network also has an active home health project in pre-heart transplant care and osteomy/wound management.[123]

Arizona Health Sciences Center Mission

> The mission of the Arizona Health Sciences Center (AHSC) is to provide health care education, research, patient care and service for the people of Arizona. Our faculty, staff and students consistently fulfill that mission by offering their expertise in health care programs throughout Arizona. One such program allows nursing, pharmacy and medical students to take part in statewide rural rotations, living and learning in areas ranging from the U.S.-Mexico border to Native American communities in Northern Arizona.[124]

[123] Ibid., 13.

[124] Arizona Health Sciences Center, "AHSC Mission" Available at http://www.ahsc.arizona.edu/welcome/ahsc_mission.html



= Department of Corrections Site
= Rural Site
= Indian Health Services Site

Figure 15.
Arizona Telemedicine Program Sites[125]

[125] University of Arizona, Arizona Telemedicine Program, "Arizona Telemedicine Program Sites," (May 3, 2001). Available at http://www.telemedicine.arizona.edu/program/sites.html

Arizona Telemedicine Goals

- To enhance health care delivery to medically underserved populations throughout the state using telemedicine technologies
- To establish a statewide Arizona Rural Telemedicine Network
- To increase access to medical specialty services while decreasing health care costs
- To use telemedicine outreach programs to encourage physicians, nurses, and other health care professionals to establish practices in underserved rural areas
- To provide ongoing training for preceptors, medical students, and residents
- To recruit students from rural communities into the health care professions and encourage their return to these communities upon completion of their educations
- To improve public health in rural communities by providing current information and training for rural county health departments
- To have the Arizona Rural Telemedicine Network serve as a test bed for various state agencies to evaluate the effectiveness of state-of-the-art telemedicine services
- To increase and promote the use of telecommunications for distance learning in health care
- To provide health care systems throughout the state with information, training, and expertise in the field of telemedicine
- To evaluate telemedicine equipment and telecommunications options and participate in their development
- To perform telemedicine needs assessments for state agencies
- To expand current undergraduate, graduate, and postgraduate education programs in telemedicine
- To support and promote the economic development of the State of Arizona (e.g., Senior Living Program, etc.). [126]

[126] Arizona Telemedicine Program, "Arizona Telemedicine Program Goals," (May 3, 2001). Available at http://www.telemedicine.arizona.edu/program/goals.html

East Carolina University Telemedicine Center (Sites, Figure 16)

The East Carolina University (ECU) Telemedicine Center began providing telemedicine services in 1992. The current network consists of 22 interactive conference and clinical sites plus four store-and-forward sites and two tele-mental health networks. The newest site is a link to the North Carolina School for the Deaf for pediatric care and child psychiatry.

In addition to many medical specialties, the network provides non-physician services, such as diabetes management, speech pathology, pharmacy, social services, nutrition clinics, and various clinical nurse specialist services. The network is used often for supervision of health professional students and residents, continuing education and administrative meetings.[127]

East Carolina University Medical Center Mission

The Medical Center has the mission to promote and facilitate Service, Education, and Research in health care throughout the region.[128]

ECU Telemedicine, Institute for Interventional Informatics (I^3) Goals

1. Integration of I^3 technologies for disabled persons
2. Integration of I^3 technologies into home health and telemedicine situations
3. Development of a team that continues to import and develop these technologies as part of a new CHSC Rapid Prototyping Center modeled after the I^3 method
4. Continue to establish and maintain social cohesion and collaboration between I^3 and CHSC

[127] Ibid., 43.

[128] ECU Joyner Library, "Medical Center Mission Statement," (November 20, 2000). Available at http://www.lib.ecu.edu/SpclColl/Archives/pr104.html

5. Continue to establish collaborations within the university to promote production of projects [129]

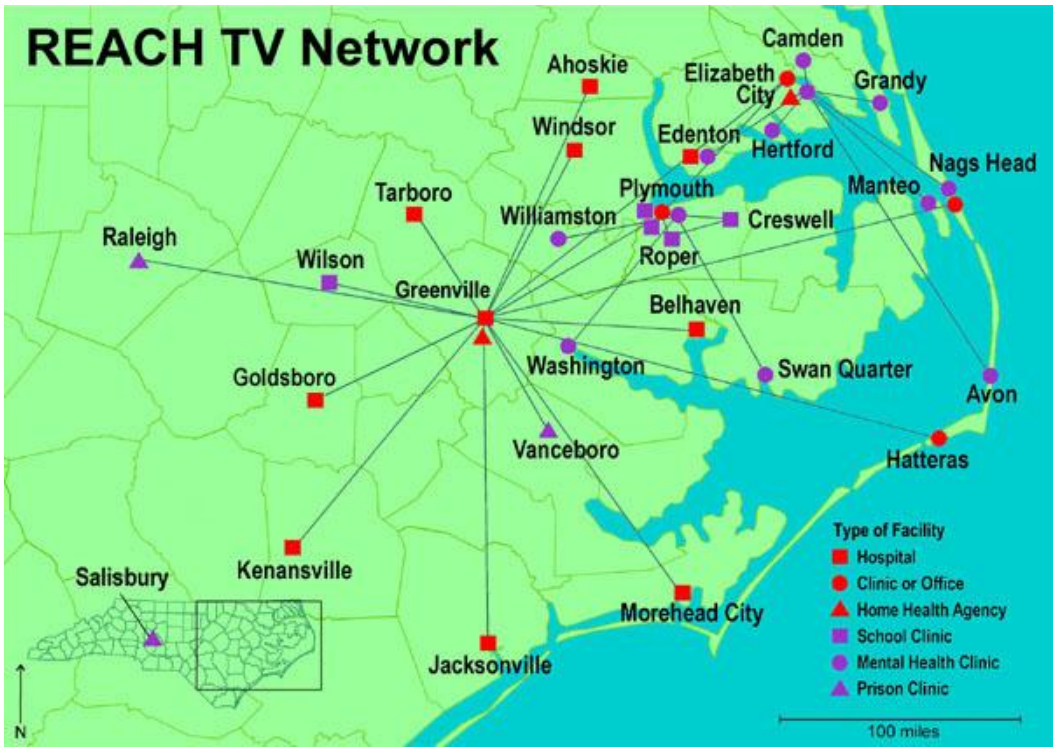


Figure 16.
ECU Telemedicine Sites[130]

[129] ECU Telemedicine Center, "Interventional Informatics Goals," (August 14, 2001). Available at http://www.telemed.med.ecu.edu/2001/interventional/goals.htm

[130]East Carolina Telemedicine Network, "Site Map." Available at http://www.telemed.med.ecu.edu/2001/sitemap/

Non-academic Medical Systems

Eastern Montana Telemedicine Network (Sites, Figure 17)

> Operational since September of 1993, the Eastern Montana Telemedicine Network is a consortium of 15 not-for-profit medical and mental health facilities. From July 1999 to June 2000, a total of 1,825 video-conferences were conducted over EMTN with over 12,000 participants.
>
> In addition … the network has conducted clinical services in pathology, gastroenterology, pediatrics and ENT. Other clinical applications include registered dietician services, employee assistance counseling and geriatric assessment services. Medical and mental health services represent over 60 percent of the total activity on the network. The system is also used for educational programs, administrative and tele-business services, and supervision of family practice residents during their rural rotations.
>
> Through the planned addition of North Big Horn Hospital in Wyoming, a connection to the Shriners Children's Hospital in Utah will be made twice a month for assessment and follow-up services to orthopedic and burn patients living in the Basin area of Wyoming."[131]

Eastern Montana Deaconess Billings Clinic Mission

> Deaconess Billings Clinic's mission is to improve the health of the citizens of our region through health care, education and research. As a not-for-profit organization, care is provided regardless of ability to pay.[132]

Eastern Montana Telemedicine Network Goal

> To utilize two way interactive video conferencing technology to deliver specialist medical and mental health services, continuing medical and higher education, administrative and tele-business services regionally and nationally.[133]

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[131] Office for the Advancement of Telehealth, 35.

[132] Eastern Montana Telemedicine Network, "EMTN Network Office, Deaconess Billings Clinic." Available at http://www.emtn.org/site2_1.html

[133] Eastern Montana Telemedicine Network, "EMTN Summary." Available at http://www.emtn.org/summary.html

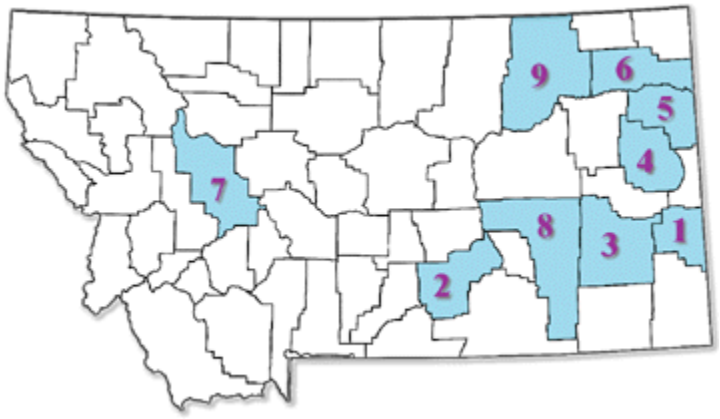

Figure 17.
Eastern Montana Telemedicine Network Sites[134]

1. Fallon County County Medical Complex, Baker, Montana

2. Yellowstone County – Billings, Montana
   EMTN Office at Deaconess Billings Clinic
   Deaconess Billings Clinic Behavioral Health Clinic
   Yellowstone City-County Health Department
   Montana Family Practice Residency

3. Custer County
   Eastern Montana Community Mental Health Center, Miles City, Montana

4. Dawson County – Glendive Medical Center

5. Richland County – Sidney Health Center

6. Roosevelt Memorial Hospital and Nursing Home, Culbertson, Montana

7. Lewis & Clark County – Helena, Montana
   Montana Healthcare Association

8. Rosebud County – Colstrip Medical Center

9. Valley County – Glasgow, Montana
   Frances Mahon Deaconess Hospital

[134] Eastern Montana Telemedicine Network, "EMTN Sites." Available at http://www.emtn.org/sites.html

Marshfield Clinic TeleHealth Network (Sites, Figure 18)

Since 1997, the Marshfield Clinic TeleHealth Network has supported an integrated system of health care delivery in 39 regional centers. Six Marshfield Clinics provide consultants who practice medicine over the network in eleven other regional centers, one affiliated hospital as well as one independent physician service organization and rural hospital.

In addition to the services listed above, the network has provided consultations in plastic surgery, neurology (sleep studies, snoring assessments), and emergency services. The system is also used for business and operational meetings, as well as CME and community education. The network is the only medical facility linked to BadgerNet, the statewide video conference and educational system.

Marshfield Clinic has assisted the St. Paul Regions Hospital Burn Center in conducting follow-up care of burn patients. In the next two years, the network will expand to schools and long term care facilities, including nursing homes, home health and hospice.[135]

Marshfield Clinic, Mission

The mission of Marshfield Clinic is to serve patients through accessible, high quality health care, research and education.[136]

Marshfield Clinic Objectives

- Customer Focus: The services we provide will be determined by the needs of the customer
- People Orientation: We will treat our people as Marshfield Clinic's most important asset
- System Integration: Marshfield Clinic will be an integrated, synergistic health care delivery system

[135] Office for the Advancement of Teleheatlh, 68.

[136] Marshfield Clinic, "Mission Statement" (February 2002). Available at http://www.marshfieldclinic.org/home/about/mission.stm

- Financial Stability: Marshfield Clinic will attain and maintain financial stability. [137]

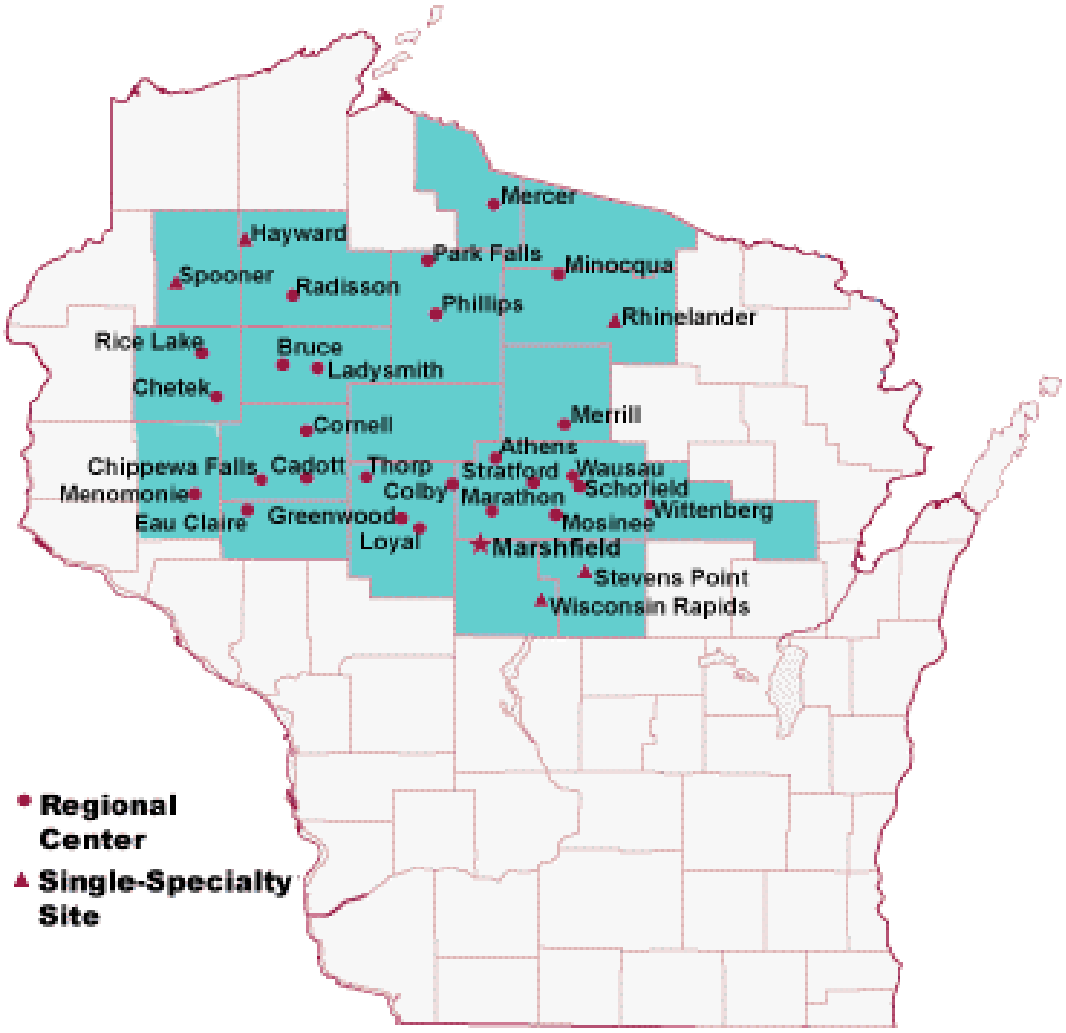

Figure 18.
Marshfield Clinic Sites[138]

★ = Marshfield Clinic Hub Site

[137] Ibid.

State-wide Telemedicine Networks

Kansas Center for TeleMedicine and TeleHealth (Sites, Figure 19)

The Center for TeleMedicine & TeleHealth at the University of Kansas Medical Center is a pioneer in telemedicine activity and research. In the late eighties and early nineties, the idea of telemedicine and its practice were coming together to serve a rural population desperately lacking access to medical services. Inspired by this challenge, affiliates at the Kansas University Medical Center began creating a telecommunication network that would reach under-served Kansans throughout the state. Remarkably, in 1999 alone the TeleMedicine program conducted 2,207 consultations making it one of the top five most active telemedicine sites in the world.

In 1999, KU received the prestigious President's Award presented by the American Telemedicine Association for historic contributions in the advancement of telemedicine. Delivering health services, both clinical and educational, through telemedicine technologies raises a plethora of questions, ranging from efficacy to cost benefit issues. KU's Center for TeleMedcine and TeleHealth's team of researchers seeks to broaden universal knowledge of telemedicine by demanding rigorous study of this application, rather than the traditional dependence on anecdotal evidence.

In its first 8 years, affiliates of KUCTT have published more than 100 research-based articles in more than 30 academic and research journals.[139]

University of Kansas Medical School Mission

- Quality education for medical students and residents to become competent, compassionate physicians, and continuing medical education to maintain proficiency;

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[138] Marshfield Clinic, "Marshfield Clinic Centers." Available at http://www.marshfieldclinic.org/centers/map.asp

[139] The University of Kansas Medical Center, Center for Telemedicine and TeleHealth, "History" (2001). Available at www2.kumc.edu/telemedicine/history.html.

- Improved medical services for the people of Kansas, particularly in underserved communities; and
- A supportive environment for biomedical research.[140]

Figure 19.
Kansas University Center for TeleMedicine and TeleHealth
ITV Sites[141]

[140] University of Kansas Medical Center, "Mission Statement." Available at http://wichita.kumc.edu/info/mission.html

[141] University of Kansas, Center for TeleMedicine and TeleHealth, "ITV Sites." Available at http://www2.kumc.edu/telemedicine/itvcom.html

Kansas University Center for TeleMedicine and TeleHealth Mission

- Provide clinical services to Kansans using cutting-edge technologies
- Provide wellness education to Kansans and professional education to Kansas health professionals using cutting-edge technologies
- Serve as a site for research and development in the delivery of clinical and educational services using cutting-edge technologies.[142]

Kansas University Center for TeleMedicine and TeleHealth Goals

- Seek opportunities to apply TeleMedicine and TeleHealth tools and methods to improve the delivery of healthcare
- Support the development of a TeleHealth network in Kansas
- Support the delivery of KUMC clinical services through TeleMedicine
- Use TeleMedicine and TeleHealth tools and methods to provide professional development to healthcare providers and health and wellness information to healthcare consumers
- Conduct research into the efficacy, cost, and implementation of TeleHealth delivery
- Participate in the development of state and national policy related to TeleHealth
- Evaluate new information and communications technologies for possible integration into the TeleHealth toolkit and develop related clinical delivery models as appropriate.[143]

[142] University of Kansas Medical Center, Center for Telemedicine and TeleHealth, "Our Mission." Available at http://www2.kumc.edu/telemedicine/mission.html

[143] Ibid.

Missouri Telehealth Network (Sites, Figure 20)

University of Missouri Health Care is the hub site for the Missouri Telehealth Network (MTN), which covers a geographic area representing approximately 22 percent of the state's rural population. Four of the 16 rural counties where MTN operates are federally designated Health Professional Shortage Areas. MTN has been operational since the summer of 1995.

In terms of rural services, the network provides both teleradiology and interactive video encounters to six sites, interactive video services to nine sites, and teleradiology services for three sites. MTN has two sites that are part of the Area Health Education Center (AHEC) network: an urban site in St. Joseph and a rural site in Rolla. MTN provides services to special populations, such as children with special needs and traumatic brain injury patients.[144]

University of Missouri Healthcare Mission

As part of a land-grant university, University of Missouri Health Care's core mission is to provide education, research and service to the residents of Missouri with an emphasis on rural Missouri.[145]

University of Missouri Healthcare Vision

To offer programs of unsurpassed excellence that will be integrated into a highly efficient, fiscally sound, professionally outstanding, service-oriented health system that is unified in a common purpose to be one of the premier comprehensive academic health systems in the nation.[146]

[144] Office for the Advancement of Teleheatlh, 37.

[145] University of Missouri Healthcare, "Mission and Vision of MU Healthcare," (November 9, 2001). Available at http://www.muhealth.org/~center/missionvision.shtml

[146] Ibid.

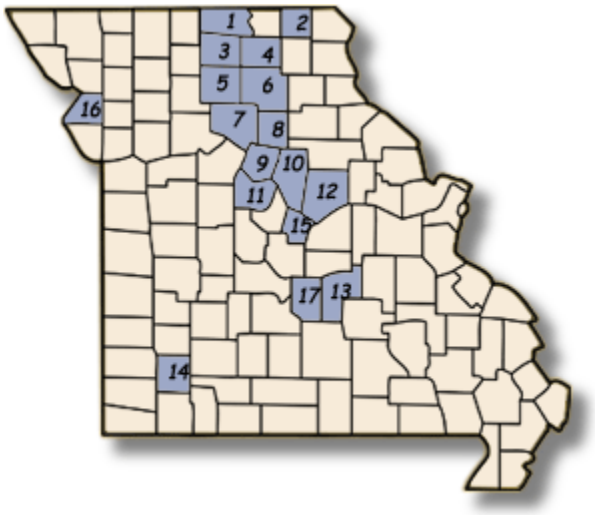

Figure 20.
Missouri Telehealth Network Sites[147]

1. Putnam County Memorial Hospital, Unionville
2. Scotland County Memorial Hospital, Memphis
3. Sullivan County Memorial Hospital, Milan
4. Kirksville College of Osteopathic Medicine, Kirksville
5. Pershing Memorial Hospital*, Brookfield
6. Loch Haven Nursing Home, Macon
6. Samaritan Memorial Hospital*, Macon
7. Keytesville Clinic, Keytesville
8. Moberly Regional Medical Center, Moberly
9. Fayette Medical Clinic, Fayette
10. Ellis Fischel Cancer Center, Columbia
10. University of Missouri-Health Sciences Center, Columbia
11. Cooper County Memorial Hospital, Boonville
12. Callaway Physicians, Fulton
13. Phelps County Regional Medical Center*, Rolla
14. Missouri Rehabilitation Center, Mount Vernon
15. Capital Region Medical Center, Jefferson City
16. Heartland Health System, St. Joseph
17. General Fort Leonard Wood Hospital, Ft. Leonard Wood

[147] Missouri Telehealth Network, "MTN Sites." Available at http://www.muhealth.org/~telehealth/geninfo/sites.shtml

Insurer-Based Programs

Insurer-based One Telemedicine Demonstration Project

Insurer-based One is a statewide telemedicine demonstration project designed to increase access to specialty care. The program was made possible through a $1.8 million Rural Health Demonstration Project award as part of a state-sponsored insurance program offering low-cost health, dental and vision coverage to children of low-income working families.

The telemedicine program uses computer technology and the existing insurance network to help physicians expand access to quality healthcare and erode the barriers of distance, time, cost, and language that have prevented people in medically underserved rural areas from receiving state-of-the-art diagnosis and treatment.

Rural Telemedicine Demonstration Project Goals

1. Expand access to specialty health care services for rural residents
   Objective 1: increase availability of specialists
   Objective 2: build utilization in specialty provider shortage areas
   Objective 3: improve access for members in medical groups

2. Evaluate the acceptability of TM and the impact on care from a patient and provider perspective
   Objective1: quantify the acceptability of using telemedicine by patients and providers
   Objective 2; identify the impact on care from a provider perspective
   Objective 3: quantify changes in cost, distance and time for patients using TM

3. Develop a sustainable telemedicine model
   Objective 1: develop reimbursement policy
   Objective 2: develop claims and billing methodology.[148]

Insurer-based Two E-Health

Insurance-based Two is one of the nation's largest nonprofit health maintenance organizations. To leverage its size and information assets, in 1996, it restructured its information technology organization from regional operations to a national structure to deploy and share information across the country.

Insurer-based Two members in certain areas of the country can access drug and medical encyclopedias, request appointments, and ask confidential questions of advice nurses and pharmacists. They can also access health plan benefit options, research local health education classes, access physicians' directories, and directions to facilities.

E-Health Goal

Insurer-based Two Interactive Technologies Initiative's goal is extending patient-driven service to the benefit of choice, access, quality and ever improving relations between its clinicians and members.

Comments

All of the organizations in this study include education, research, and either service or healthcare in their mission statements. The six telemedicine or telehealth programs that have telemedicine-specific missions, goals, and/or objectives mention

increasing or expanding the delivery, enhancement, or access to healthcare, and three specify increasing healthcare delivery to underserved or disabled populations.

Background Questions

1. What is the official name of your telemedicine/telehealth system?

2. Is that the original name or has the name changed over time?

Five of the eight programs contain the term "telemedicine" in their names, including the two academic medical systems, Arizona Telemedicine Program and East Carolina University Telemedicine Program, and one each in the other three categories, Eastern Montana Telemedicine Network (non-academic medical system), Kansas University Center for TeleMedicine and TeleHealth (state-wide network), and Insurer-Based One Rural Telemedicine Demonstration Project.

Three use the term "telehealth," one non-academic health system, Marshfield Clinic TeleHealth Network, and both state-wide networks, Missouri Telehealth Network, and Kansas University Center for TeleMedicine and TeleHealth, which incorporates both terms. Insurer-Based Two's system is known as "E-health."

Both the academic medical system telemedicine programs have alternative names for their network communications infrastructure. Arizona Telemedicine Program Network is also known as Arizona Rural Telemedicine Network (ARTN) and East Carolina's program also known as REACH-TV (Rural Eastern Carolina Health Television).

Five of the eight systems, both academic, both non-academic and one insurer-based, continue to use their original names. Both state-wide networks had a name change. Missouri Telemedicine Network became Missouri Telehealth Network. Kansas Telemedicine became Information Technology Services and Research (ITSR) then Kansas University Center for TeleMedicine and TeleHealth. Insurer-based Two program changed from "Tele-Homecare" to "E-health."

3. When and how did telemedicine begin in your organization? **(Figure 21)**

Academic Medical Systems

In 1996, the University of Arizona Medical School was given a mandate and funding by the state legislature to develop a telemedicine program that would provide healthcare services to rural communities, Indian tribes, and rural prisons.

East Carolina University already had a distance learning program when the state's largest prison contracted with ECU School of Medicine to provide telemedicine services beginning in 1992.

Non-Academic Medical Systems

Eastern Montana's Deaconess Billings Clinic outreach services began investigating the possibility of using interactive video as a pilot project in 1992. A Rural Utilities Services grant funded equipment for the first five rural sites that became operational in 1993, while an in-house grant funded Deaconess Billings Clinic as the telemedicine hub site.

Wisconsin's Marshfield Clinic TeleHealth Network was developed in 1997 with a $1 million grant from the Office of Rural Health Policy to increase access to specialty healthcare services in remote areas of northern, central and western Wisconsin.

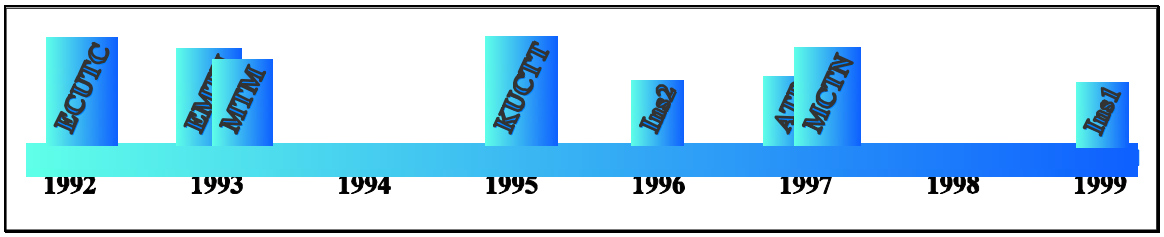

Figure 21.
Timeline of Telemedicine Programs by Year They Began

ECUTC = East Carolina University Telemedicine Center

EMTN = Eastern Montana Telemedicine Network

MTM = Missouri Telehealth Network

KUCTT = Kansas University Center for TeleMedicine and TeleHealth

Ins2 = Insurance-Based Telemedicine Program

ATP = Arizona Telemedicine Program

MCTN = Marshfield Clinic TeleHealth Network

Ins1 = Insurance-Based Telemedicine Program

State-wide Telemedicine Networks

The University of Kansas Medical Center began with educational services, then in 1993 began offering clinical services over the system. In 1995, the state legislature provided funding for a staff at the Medical Center to support telemedicine clinical activities.

Missouri Telehealth Network began in 1993 as a collaborative effort in the University of Missouri-Columbia School of Medicine's Department of External Affairs, the Missouri Public Service Commission, Southwestern Bell, GTE, AT&T, Northeast Missouri Rural Telephone and ALLTEL Missouri to understand how advanced telecommunications technologies could improve access to quality medical care. In 1994, an Office of Rural Health Policy grant and support from telephone companies created one of the largest public-private telemedicine partnerships in the nation.

Insurer-Based Systems

In 1999, Insurer-based One was awarded a $1.8 million grant from a state fund to establish a telemedicine demonstration project to enhance the quality of healthcare to rural populations including migrant workers and Native Americans.

In 1995, Insurer-based Two Interactive Technologies Initiative (ITI) began a pilot Tele-Home Health project in response to a shortage of healthcare providers and with the goal of improving member access to quality healthcare.

4. Was any sort of needs assessment done in the beginning stages?

A formal needs assessment was conducted by only three of the eight systems, one academic-based, one non-academic based, and one insurer-based program.

Arizona Telemedicine conducted needs assessments and tested technology for eight months before becoming operational. Marshfield Clinic TeleHealth based its program design on needs assessments in two rural Wisconsin counties. According to the key informant for Insurer-based One, needs assessments were conducted to identify provider shortage areas prior to telemedicine sites being chosen.

The five programs that did not conduct formal needs assessments cited reasons such as the obviousness of the need to improve access to medical care, healthcare provider shortages, and the documentation of subspecialty needs in rural areas.

5. Is telemedicine a separate department or is it integrated into other departments?

The two insurer-based programs and one non-academic medical system, Marshfield Clinic, are the most integrated within their organizations. The telemedicine program itself is run by only one or two persons who facilitate the integration of telemedicine throughout the system by using their organizations' resources.

The second non-academic medical system, Eastern Montana, is a network, a consortium of twenty not-for-profit members whose hub site is the main clinic in the system.

Both academic medical systems telemedicine programs are a separate program located within their medical schools, Arizona within the Department of Pathology and East Carolina within the Department of Health Communications.

Both state-wide telemedicine systems are headquartered in state university medical schools, Kansas within the Department of Information Technology and Missouri within the Department of External Affairs.

6. How many full-time employees work in your telemedicine system?

7. How many part-time employees? (Table 3)

Academic Medical Systems

Arizona Telemedicine employs twenty-two, including four full-time employees, two telemedicine coordinators, a distance education coordinator and an administrative assistant. Grants fund about 90 percent of the associate director, 50 percent of the medical director and chief information officer, and 40-50 percent of the three telemedicine technicians.

East Carolina Telemedicine Center is headed by a director and has a large staff that includes a telemedicine grants project manager, a distance education coordinator, four telemedicine program coordinators, two telemedicine training coordinators, two telecommunications engineers and two media technicians. In addition, for the National Library of Medicine Next Generation Internet Project, there is a project manager, a project assistant, a network telecommunications engineer, and an evaluation/research director.

Table 3.
Telemedicine Program by Number of Employees

	Full-time	**Part-time**
Arizona	4	18
ECU	17	2
E Mont.	4	.5 per site
Marshfld	3	4
Kansas	13	2
Missouri	4	4
Ins1	CCI*	CCI*
Ins2	CCI*	CCI*

*CCI = Company Confidential Information

Non-academic Medical Systems

Eastern Montana has four full time employees, a telemedicine director, two telemedicine technicians and a telemedicine RN. Each site supports a .5 FTE as part of their commitment to membership in the telemedicine network.

Marshfield Clinic TeleHealth is headed by a program manager. Two telemedicine medical clinicians are supported by grant funding. The other employees are funded internally by the clinic, including human resources drawn from the organization as time commitments, such as an estimated .2 medical director, a .2 administrative director, a .2 information services personnel, and a .2 scheduler.

State-wide Telemedicine Networks

Kansas telemedicine has thirteen full-time employees, including four project managers, a project coordinator, two video technicians, a media production manager, and two part-time research assistants.

Missouri telemedicine has four full-time employees, an executive director, an assistant director, an administrative associate and an administrative assistant. Four part-time employees include a coordinator of program and project support, a continuing education coordinator, a network support specialist, and a user support analyst.

Insurer-based Programs

Insurer-based One's Telemedicine Demonstration Project has two full-time employees, a clinical research manager and a business development manager.

Insurer-based Two's E-Health is overseen by an e-health manager who uses organizational resources to integrate e-health throughout the system.

Both key informants from insurer-based systems were reluctant to identify or even estimate the number of medical personnel within their systems involved in telemedicine or telehealth.

8. Using Grigsby's classification scheme,[149] which general applications and processes of telemedicine do your organization provide? **(Table 4)**

- ***a. Initial urgent evaluation and triage***
- ***b. Medical and surgical follow-ups***
- ***c. Primary care consultations***
- ***d. Specialty consultations and second opinions***
- ***e. Transmission of digital diagnostic images***
- ***f. Diagnostic work-ups for specific conditions***
- ***g. Monitoring of chronic diseases and conditions***
- ***h. Transmission of medical data***
- ***i. Public health and education***

[149] Jim Grigsby, Robert E. Schlenker, Margaret M. Kaehny, Peter W. Shaughnessy, and Elliot J. Sandberg, "Analytic Framework for Evaluation of Telemedicine," *Telemedicine Journal* 1 (1995), 36-37.

Table 4.
Telemedicine Program by General Applications

	a. Triage	b. Med-F/U	c. Prim care	d. Spec. consult	e. Trans images	f. Diag W/U	g. Monitor	h. Trans data	i. Pub Hlth
Arizona	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
ECU	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
E Mont.	Yes	Yes	No	Yes	Yes	Yes	Dev*	No	Yes
Marshfld	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Kansas	Yes	Yes	Yes	Yes	Dev*	Yes	Yes	No	Yes
Missouri	No	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes
Ins1	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ins2	No	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes

*Dev = In development

9. ***Using Reid's classification scheme of telemedicine (Level of Service, Setting, Healthcare Discipline, Technology Used, Equipment, Activity Conducted),[150] what level of service(s) does your organization provide? (Table 5)***
    a. ***Tele-Consultation***
    b. ***Tele-Care***
    c. ***Tele-Monitoring/Mentoring***
    d. ***Telehealth Education***
    e. ***Other***

[150] Jim Reid, "Telemedicine Applications: Today and in the Future," slide presentation (1998). Available at www.telemedprimer.com/htb1198/tsld001.htm.

Other Services

The two insurer-based programs both have a virtual library of online health information resources.

10. What are the settings (end-user locations)? (Table 6)

- ***a. Hospital***
- ***b. Clinic***
- ***c. Home***
- ***d. Prison***
- ***e. Workplace***
- ***f. Other***

Table 5.
Telemedicine Program by Level of Service

	a. Tele-Consult	b. Tele-Care	c. Tele-Monitoring	d. Telehlth Education
Arizona	Yes	Yes	Yes	Yes
ECU	Yes	Yes	No	Yes
E Mont.	Yes	Yes	No	Yes
Marshfld	Yes	Yes	No	Yes
Kansas	Yes	Yes	No	Yes
Missouri	Yes	No	No	Yes
Ins1	Yes	No	No	Yes
Ins2	Yes	Yes	Yes	Yes

Table 6.
Telemedicine Program by Setting

	a. Hospital	b. Clinic	c. Home	d. Prison	e. Work	f. School	f. Nursing Home
Arizona	Yes	Yes	Yes	Yes	No	Yes	No
ECU	Yes	Yes	Yes	Yes	No	Yes	No
E Mont.	Yes	Yes	Dev*	No	No	No	No
Marshfield	Yes	Yes	Yes	Dev*	No	Yes	Yes
Kansas	Yes	Yes	Yes	No	No	Yes	Dev*
Missouri	Yes	Yes	No	No	No	No	Yes
Ins1	No	Yes	No	No	No	No	No
Ins2	Yes	Yes	Yes	No	Dev*	No	No

*Dev = In development

Additional Sites

Arizona's telemedicine program is multicultural, offering services to Native American and Hispanic communities. ECU Telemedicine spoke sites include mental health clinics, a school for the deaf, and a planned connection to a mental health hospital.

Insurer-based One has five specialty hub sites and thirty-eight primary care clinic spoke sites throughout the state.

Eastern Montana Telemedicine has a spoke unit in the Montana Hospital Association headquarters. Marshfield Clinic has spoke sites in dialysis clinics as well as physician clinics.

Kansas Telemedicine sites include community mental health clinics. Missouri Telehealth sites include two health education centers for third-year hospital residents in rural areas.

11. What healthcare disciplines use your telemedicine system?

- ***a. Medical specialty (Family Practice, Dermatology, etc.)***
- ***b. Nursing (Acute care, Home health, Hospice)***
- ***c. Allied health (PT, OT, Nutritionist, etc.)***
- ***d. Other***

Academic Medical Systems

Arizona Telemedicine offers fifty-three medical specialties, the top five of which are radiology, pathology, dermatology, psychology and cardiology. The telemedicine

network offers wound management and ostomy nursing specialties and allied health, such as physical therapy, to children with specific healthcare needs.

East Carolina Telemedicine offers more than thirty specialties. The main ones are dermatology, cardiology, psychology, pulmonary, endocrinology, obstetrics, rehab, and allergy.

Non-academic Medical Systems

All of the specialists at Deaconess Clinic are available for the Eastern Montana Telemedicine, including dermatology, neurology, orthopedics, pathology, radiology, pediatrics, emergency medicine, internal medicine, oncology, infectious disease, gastroenterology, neurology, burn care and mental health services. The top specialties of the telemedicine network are mental health; ear, nose, throat; and diabetes education. Nursing specialties include diabetes education and cardio-vascular follow-up care. Two nutritionists work collaboratively with the diabetic education nurse.

Marshfield Clinic TeleHealth offers specialty services in dermatology, oncology, occupational therapy, occupational medicine, burn management, cardiology, child psychiatry, clinical psychology, clinical social work therapy, diabetes management, disease-state management, employee assistance counsel, emergency services, nephrology, neurology, nutrition, plastic surgery, psychiatry, speech pathology. Nursing specialties include home healthcare, disease-state management, nurse triage, high-risk obstetric assessment, general internal medicine and jail services. Allied health specialties include occupational therapy, speech therapy, and nutrition.

State-wide Telemedicine Networks

The Kansas Center for TeleMedicine and TeleHealth offers tele-psychiatry, tele-oncology, tele-hematology, tele- rheumatology, and allergy/immunology telemedicine. The busiest is a pediatric program offered in Kansas schools, TeleKid Care®.[151] Nursing specialties include the previously listed medical specialties as well as tele-hospice care. Allied specialists include occupational therapists and social workers

The top specialties at Missouri Telehealth are tele-radiology, tele-dermatology and three types of tele-psychiatry: adult, child, and geriatric. In addition, Missouri Telehealth offers services in cardiology, children with special needs, emergency medicine, neurology, OB/GYN, orthopedics, physical medicine and rehabilitation, surgical follow-up, and wound care. MTN has also done some work in the areas of child health, endocrinology/diabetes, and nephrology.

Insurer-based Systems

Insurer-based One offers twenty-seven specialty categories. Top specialties are dermatology, endocrinology, psychiatry, neurology, especially pediatric neurology, and a combined infectious disease/hepatology.

Insurer-based Two offers tele-radiology, tele-dermatology, tele-rehab and disease management medical specialties. Nursing specialties offered include home health, hospice, wound care, and enterostomal therapists.

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[151] University of Kansas Medical Center, Center for TeleMedicine & TeleHealth, "TeleKid Care®." Available at http://www2.kumc.edu/telemedicine/tkc.html

12. What telemedicine technology system(s) are used by your organization? (Table 7)

- ***a. Interactive video***
- ***b. Store & Forward***
- ***c. Other***

13. What kind(s) of equipment is used in this system? (Table 8)

- ***a. Room systems***
- ***b. Rollabouts***
- ***c. PCs***
- ***d. Mobile***
- ***e. Set top boxes***
- ***f. Other***

Table 7.
Telemedicine Program by Technology

	a. Interactive Video	**b. Store & Forward**
Arizona	Yes, 40%	Yes, 60%
ECU	Yes	Yes
E Mont.	Yes, 100%	No
Marshfield	Yes, 100%	No
Kansas	Yes, 100%	No
Missouri	Yes, all non-radiology	Yes, tele-radiology
Ins1	Yes, most	Yes
Ins2	Yes, 100%	No

Table 8.
Telemedicine Program by Equipment

	a. Room Systems	b. Roll-abouts	c. PCs	d. Mobile	e. Set-top Boxes
Arizona	Yes	Yes	Yes	No	Yes
ECU	Yes	No	Yes	No	Yes
E Mont.	Yes	Yes	No	No	No
Marshfield	Yes	No	Yes	No	Yes
Kansas	Yes	Yes	Yes	No	Yes
Missouri	Yes	No	Yes	No	Yes
Ins1	No	Yes	Yes	No	No
Ins2	Yes	No	Yes	Yes	Yes

14. What kind of activity is conducted with telemedicine in your organization? (Table 9)

- ***Clinical***
- ***Educational (Adult, Medical, Nursing, Allied)***
- ***Administrative (Meetings, Recruitment, Compliance Q&A)***
- ***Business (Community business, Social orgs, Government orgs)***
- ***Other***

15. How is your telemedicine system funded? (Table 10)

a. Grants

b. In-house

c. Insurance reimbursement

d. Other

Additional Sources of Funding

East Carolina and Eastern Montana receive fees from their network spoke sites. Additionally, East Carolina has a telemedicine training program that generates income.

Both insurer-based programs are funded internally, as well as by grants. Insurer-based Two additionally receives funding from public pharmaceutical companies.

Three programs are funded by their state legislatures. Arizona and both state-wide programs, Kansas and Missouri are funded by federal grants as well as by their respective state legislatures.

Table 9.
Telemedicine Program by Activity

	a. Clinical	**b. Educational**	**c. Administrative**	**d. Business**
Arizona	Yes	Yes	Yes	No
ECU	Yes	Yes	Yes	No
E Mont.	Yes, 65%	Yes, 25% CME*	Yes	Yes
Marshfield	Yes	Yes	Yes	Yes
Kansas	Yes	Yes	Yes	No
Missouri	Yes	Yes, CME*	Yes	No
Ins1	Yes	Yes, Pt & CME*	Yes	Yes
Ins2	Yes	Yes	Yes	Yes

*CME = Continuing Medical Education

Table 10.
Telemedicine Program by Funding Source

	a. Grants	b. In-House	c. Insurance	d. State Legislature
Arizona	Yes	Yes	Yes	Yes
ECU	Yes	Yes	Yes	No
E Mont.	Yes	Yes	Yes	No
Marshfield	Yes	Yes	Yes	No
Kansas	Yes	Yes	Yes	Yes
Missouri	Yes	Yes	Yes	Yes
Ins1	Yes	Yes	N/A	No
Ins2	Yes	Yes	N/A	No

About two-thirds of Kansas' budget is funded through federal and local foundation grants. The Kansas State Legislature funds the telemedicine program as a line item and recently awarded additional money from the tobacco settlement for statewide fellowships.

16. Does your organization collect data and generate reports on telemedicine activity?

a. What kinds of data are collected?

b. Who compiles the data and writes the report?

Academic Medical Systems

Arizona has an assistant director for evaluation, a medical statistician, who compiles the data and writes the reports.

Most of the reporting done by East Carolina Telemedicine has been grant reporting. Reporting is also required by the university for all its centers and institutes.

Non-Academic Medical Systems

Eastern Montana generates and distributes reports as a way to communicate the value of the network to its partners. The Telemedicine Director is responsible for collecting data and writing reports. Data are collected about individual site usage and how much money is saved in travel costs for network employees or for education.

Marshfield Clinic TeleHealth Network generates federal grant reports quarterly and annually, which are also distributed internally, on utilization statistics and data on patient and provider satisfaction. Marshfield has also done some time-motion studies comparing telemedicine or telehealth and traditional medicine, a large clinical outcomes study in tele-dermatology and plan to do another outcomes study for telemedicine in long-term care.

State-wide Telemedicine Networks

Kansas Telemedicine collects data on utilization trends, acceptance, and cost studies. Two research assistants collect data and help with the interpretation and two health economists are working with the network on cost studies.

Missouri Telehealth collects data on how far patients would have had to travel without telehealth and/or how long would they have waited for a specialist to travel to their community.

Insurer-based Systems

Insurer-based One's Clinical Research Manager compiles the data and writes reports. Data collected include utilization, time and distance savings, patient and provider satisfaction, and transfer of educational information.

Insurer-based Two's E-Health Manager is responsible for compiling data and writing reports, but is able to draw upon organizational resources, such as statisticians, if needed.

17. Does your organization offer any training in telemedicine? If so, for whom and what kind?

Academic Medical Systems

Arizona Telemedicine conducts multi-faceted training. When a new site comes on-line, the group has 2 ½ days of training involving six or eight persons: the CEO, Medical Director, Telemedicine Director, Telemedicine Coordinator, a technical person, and any physicians involved. As a follow-up, the hub site telemedicine coordinator and technology coordinator are sent to the spoke site for training. This takes place within a couple of weeks of the on-site training. The network also offers one-day training for Legislators, the Arizona Telemedicine Council, and others, as appropriate, and two-hour training sessions for an overview demonstration. Arizona also conducts an annual Telemedicine Corrections Conference, the last of which, the 3rd Annual Corrections Conference, was attended by 235 with 30 vendors.

East Carolina Telemedicine has a large telemedicine training center that trains people from across the United States and other countries. No, we've had people from all over the United States and other countries. The week-long training sessions allow people to spend some time with the equipment and go through a training series depending on the area of interest, whether technical, clinical, or administrative. Revenue from the training program is part of the operational budget.

Non-Academic Medical Systems

Eastern Montana TeleMedicine Network conducts significant training for telemedicine facilitators at new sites and annual training sessions at the Deaconess Billings Clinic hub site for all the site telemedicine facilitators together. Additional training and communication is done over interactive video and the director meets bi-monthly with the site facilitators to address training and operational issues.

Marshfield Clinic TeleHealth Program Manager trains telehealth nurses who then train other staff in regional centers using video-conferencing. The Program Manager also supervises telehealth training of nursing home staff and all the home health staff to present patients in a way that recreates the human interaction of the clinical consult. New employees receive two weeks of orientation in telehealth, then one or two full clinic days with each of the specialty providers. And then about once about every two months, the telehealth employees spend a few days with a specialty provider. The telehealth program manager also sits in on the first telehealth encounters with new specialty providers to provide needed coaching or training, and provides training to their staff in documentation, billing and coding.

State-wide Telemedicine Networks

Kansas University Center for TeleMedicine and TeleHealth trains school nurses for its largest program, TeleKid Care®, with two-day training sessions at the hub site.

KUCTT has a training curriculum for new specialty consultants that includes practice with peripheral telemedicine equipment, such as a tele-stethoscope or tele-otoscope.

Missouri Telehealth Network trains end users how to use the equipment. Upon installation of a new site, training personnel are sent two, three, or four times, whatever is needed to be sure that the staff is trained on how to use all the equipment. The EMS (emergency medical service) training staff and the neo-natal transport staff use the network to train personnel at the rural spoke sites.

Insurer-based Systems

The Clinical Research Manager of the Insurer-based One's Demonstration Project wrote a training manual, an operations manual and a training program that was delivered on site throughout the entire network.

Insurer-based Two's telemedicine training is conducted by whoever is running the project, usually the project manager. For instance, the Tele-Homecare Project Manager hired a nurse educator who received training from the vendor and then in turn trained the staff on how to use the equipment. In addition, in-service training is a continuing process within the system.

18. Does your organization market or publicize telemedicine to healthcare consumers? … to healthcare professionals? If so, what kind?

Academic Medical Systems

Arizona Telemedicine has an extensive Web site, http://www.telemedicine.arizona.edu/, and produces brochures that are sent to the legislature and to healthcare professionals throughout the state. Telemedicine personnel give talks in response to frequent requests for speakers and the Public Relations Department at the university sends out press releases to local television and newspapers.

East Carolina Telemedicine also has an extensive Web site, http://www.telemed.med.ecu.edu/, and publishes a newsletter that is sent out to all interested parties. Numerous television and news articles have featured East Carolina Telemedicine and the university Public Relations Department sends out press releases about telemedicine events or grant awards.

Non-academic Medical Systems

Eastern Montana Telemedicine Network, www.emtn.org. markets to both healthcare providers and consumers. EMTN educates, very heavily internally, to new physicians and new employees. The network sponsors frequent organizational activities that highlight telemedicine, such as open houses during TeleHealth Month. Externally, it publishes a Web site, a quarterly newsletter for healthcare providers throughout the region, and frequent articles about the telemedicine network in local newspapers. Eastern Montana is an active partner in the Montana Healthcare Telecommunication Alliance, an alliance of all the telemedicine networks throughout Montana that advocate for telemedicine throughout the state.

Although Marshfield Clinic TeleHealth has no official Web site, news stories about the telehealth network are posted on the parent organizations's Web site at http://www.marshfieldclinic.org/ . The telehealth network takes every opportunity to market internally through staff meetings and externally through community outreach activities. New programs, grants, and milestones are publicized through print and broadcast media.

State-wide Telemedicine Networks

Kansas Telemedicine does not advertise externally, except for the Web site at telemedicine@kumc.edu, because that may be seen as competing with private practitioners. The network does publish program successes in internal papers and work with the Public Relations Department of the university for press releases.

Missouri Telehealth publishes a Web site, http://www.telehealth.muhealth.org, and a brochure. The network does not market per se on TV or newspaper, but market informally to healthcare professionals through in-person visits.

Insurer-based Systems

Neither insurer-based system advertises its telemedicine program per se, but their public relations departments issue press releases and arrange requested interviews.

Insurer-based Two's tele-homecare and e-health have been featured in multiple medical journals, newspapers, and television programs: the New York Times, the Post, Chicago Tribune, NBC News, MSNBC, Fox News Network.

Evaluation Questions

19. What do you consider the greatest barriers to the growth of telemedicine in your organization?

20. What efforts has your organization made (if any) to overcome those barriers?

Academic Medical Systems

Arizona Telemedicine Program

The key informant from Arizona Telemedicine lists three major barriers to the growth of telemedicine: (1) the cost of telecommunications lines (the Universal Services program helps with this, but there is no telecommunications infrastructure in the state); 2) physician participation (over 90 physicians participate): and 3) profitability and/or sustainability.

Arizona Telemedicine's efforts to overcome barriers to growth include 1) site surveys to assess needs; 2) the purchase from department heads of ½ day clinic time to pay physicians to work an afternoon; 3) the establishment of Project Nightingale to design and implement the telecommunications infrastructure necessary to connect healthcare sites to the Arizona Telemedicine Program. Additionally, the Arizona

Telemedicine Council was established when the state legislature funded the program. The council includes such key people as the head of appropriations from the State House and Senate, representatives from government, universities, Mayo Clinic, and other key people in healthcare, corrections, telecommunications and government. The Telemedicine Council meets quarterly and are given progress reports

East Carolina Telemedicine Program.

East Carolina Telemedicine's key informant thinks that limited insurance reimbursement is a barrier. The availability of consultants is probably limited by the desire to market telemedicine. Convenience to the consultants is an issue that the key informant would like to address by having inter-office network tele-communications, although some of the sites are connected too simply to allow for interactive audio and video.

East Carolina's key informant noted that the attitudes of referring providers is the area that requires the most work, is the most time-consuming and the least rewarding for the amount of time spent. ECU Telemedicine found that primary physicians will not refer patients to specialists using telemedicine unless they are already part of his or her referral pattern.

Efforts to overcome barriers to growth include promoting telemedicine with events such as breakfasts. When a new site comes on, some of the telemedicine staff are sent to discuss problems and what the program has to offer.

Telemedicine is also marketed to new faculty members who are brought in to "test drive" telemedicine equipment and do mock consults with a rural site to become comfortable with the technology.

Telemedicine staff has also been working on reimbursements, to make it more convenient for providers. Another convenience for providers has been to offer Store-and-Forward technology for dermatology.

Non-academic Medical Systems

Eastern Montana Telemedicine Network

Eastern Montana Telemedicine's key informant claims the greatest barriers are assisting providers in understanding value and facilitating change in the way they practice medicine. Among physicians, the key informant notes, it is generally in their character, a need to see clear benefits for new and different ways of doing things to be accepted. So the barrier is not so much resistance to change as it is physicians knowing how to use this technology to make their practices more efficient and to improve quality.

Efforts to overcome barriers to growth include the formation of a telemedicine advisory group, in which each member of the consortium assists in oversight of the telemedicine network. Members of the consortium include two members from each facility that has telemedicine equipment, usually the site administrator and site telemedicine facilitator plus representatives from each of the telecom carriers, representatives from local higher education, and urban and rural physicians.

Every physician affiliated with Deaconess Billings Clinic, the telemedicine hub site, is obligated to help with the telemedicine program, if needed, for specialty consults and each new physician undergoes a telemedicine orientation process.

Marshfield Clinic TeleHealth Network.

Marshfield Clinic's key informant believes that the greatest barrier to telehealth is a shortage of specialty providers. A second barrier is that some people do not understand telehealth and its importance to providers and patients in rural areas. Sometimes, because of lack of communication, program expansion is limited because people do not understand that it is possible to do it.

Marshfield Clinic TeleHealth's key informant believes that when the technology works for them, physicians love it. An example is cited of a child psychiatrist who adopted it immediately. After using it just once, he went back to his practice, had his office staff look through his patient files, find out where they lived and how they could get to the closest video conferencing center or telehealth center.

The key informant also identifies the clinic's medical director as a "real champion" of telehealth, which is an important element in promoting telehealth use and acceptance within the organization.

State-wide Telemedicine Networks

Kansas University Center for TeleMedicine and TeleHealth

Kansas Telemedicine's key informant cited funding and space constraints at Kansas as major barriers to the growth of telemedicine locally. While KY has the infrastructure to support more activity, to be able to go to the next phase of greater activity will require more technical support personnel and more physical space for the telemedicine department. Nationally, the key informant believes that the greatest barrier to telemedicine growth nationally is adoption by providers, not acceptance by patients or reimbursement or licensure.

The key informant cites building personal relationships with healthcare providers as an important factor in recruiting healthcare specialists to use telemedicine. The key informant also believes a contractural relationship and the process of setting up a specialty telemedicine service for a specified fee, such as contracting with pediatric cardiology to set up a pediatric cardiology telemedicine service with tele-echocardiography, eliminates provider resistance.

Missouri Telehealth Network

The Missouri Telehealth key informant stated that the cost of phone lines, T-1 type lines, and lack of Medicaid reimbursement were the greatest barriers to telemedicine growth. When asked whether MTN has any problems getting providers or referrals from rural areas, the key informant responded that was probably not so much a barrier, as it is trying to continually cultivate relationships between referring physicians and specialty healthcare providers who use telemedicine. The technology is secondary to the persons providing the healthcare services.

Missouri Telehealth's key informant cites Medicare reimbursement as a barrier to telemedicine growth that has been overcome by a cooperative effort of a team of telemedicine leaders from across the country who worked on drafting the legislative language then working to see it push through the U.S. House and Senate.

In a similar effort, Missouri Telehealth is working with others organizations, such as the Public Service Commission and phone companies, in trying to find ways to get an affordable tariff established for T-1 lines.

To get the word out about telemedicine, Missouri Telehealth has established community advisory groups that meet quarterly. The advisory groups are comprised of medical personnel and representation from schools, business, industry, public health, and university extension. Updates on the telehealth network are presented and input is solicited about community healthcare needs.

Insurer-based Systems

Insurer-based One Telemedicine Demonstration Project

Insurer-based One's key informant lists organizational politics, concerns about the effect on healthcare quality, and the corporate bottom line as the greatest barriers to telemedicine growth.

The key informant cites internal research reports documenting high patient satisfaction rates and cost-effectiveness of telemedicine as an effective response to organizational barriers.

Insurer-based Two E-Health

Insurer-based Two's key informant cites resistance to change as a major barrier to the growth to telehealth, particularly by the financial decision-makers who want a guarantee of profitability.

The key informant names project managers who are champions for their telehealth projects and are enthusiastic mentors of the project within the organization as the greatest resource to overcome barriers to growth.

21. Which telemedicine applications do you consider the most successful in your organization?

22. What factors do you think have contributed to the success of these applications?

23. What do you define as success in your TM program?

Academic Medical Systems

Arizona Telemedicine Program

Arizona Telemedicine's key informant lists prison telemedicine, the Indian Health Service, distance education, and clinical telemedicine as their most successful telemedicine applications.

Factors contributing to the success of these applications include telemedicine champions and visionaries within the organization. Another factor cited by the key informant is that the network has been able to retain experienced and energetic staff.

Success is measured by the improvement to the quality of life of the people of Arizona.

East Carolina University Telemedicine Program

The key informant from East Carolina Telemedicine lists tele-dermatology as clearly the most successful, followed by tele-rehabilitation and pediatric medicine, particularly at one of the spoke sites, School for the Deaf.

The success of telemedicine's clinical operations is explained by the key informant as the result of the real need for greater access to specialty care together with the enthusiasm of the healthcare providers who are champions and advocates for telemedicine.

The key informant believes that utilization is the major indicator of success. Once a telemedicine service is sufficiently utilized, further research can be done, such as cost-benefit analysis and hospitalization rates.

Non-academic Medical Systems

Eastern Montana Telemedicine Network's key informant lists psychiatry, clinical education, and continuing medical education (CME) as its three most successful telemedicine applications.

The factors contributing to these successes were listed as meeting demand and need. There are no psychiatrists east of Billings, Montana and there would be great difficulty earning continuing medical credits without the telemedicine network because of

great distances between sites – the closest telemedicine site is 120 miles away and the farthest is more than 300 miles from the hub site.

The key informant for Eastern Montana Telemedicine defines success as having partners who believe that the network is meeting their needs and consortium members see enough value in the network to pay the price to be a part of the network.

Marshfield Clinic TeleHealth Network

Marshfield Clinic TeleHealth's key informant lists cardiology, occupational medicine, psychiatry, and nutritional services as its most successful applications. The key informant also cites burn management as a great success because of its impact, not because of the large number of patients. A burn patient can get excellent care in a local facility with local staff and the patient's own primary physician working cooperatively with a plastic surgeon via the telehealth network.

The factors most critical to the success of telehealth are the telehealth nurse clinicians and the role that they play. The nurses present the patient, act as patient advocates and work with referring providers to facilitate both communication and the patient-consulting provider relationship. Another factor is specialty physicians who are champions of telehealth within their respective specialties.

The key informant defined success as the patient having unrestricted access to appropriate care at the appropriate time, with the appropriate provider; that the consulting and primary care providers have a direct relationship that is enhanced with telehealth; and

that the patients have their clinical needs met, while feeling comfortable and safe in their local environment.

State-wide Telemedicine Networks

Kansas Center for TeleMedicine and TeleHealth's key informant lists school-based telemedicine, tele-psychology, and tele-oncology as its most successful applications.

The most important factor responsible for the successes of the program is having a champion for telemedicine who "runs with it," who has a vision, and who is willing to take a chance. Kansas Telemedicine's key informant believes that makes all the difference.

Success for telemedicine is defined by the key informant as longevity, ongoing relationships, true health care delivery teams, and the amount of utilization, although numbers alone are not as important as increasing access to healthcare in rural areas, especially sparsely populated rural areas.

Missouri Telehealth Network

Missouri Telehealth's key informant maintains that psychiatry and dermatology are the network's most successful applications.

The reason given for the success of these applications is a defined, pent-up need: a lack of mental healthcare and dermatologists throughout the state.

The key informant defined success as utilization of the telehealth network and as the provision of telehealthcare services that are otherwise nonexistent in many rural communities.

Insurer-based Systems

Insurer-based One Telemedicine Demonstration Project has only one set of applications – interactive primary care. Research indicates that the project is cost-effective and has a high satisfaction rate with telemedicine for both patients and providers.

The key informant for Insurer-based One Telemedicine defined a successful program as one that serves its stated purposes and is sustainable.

The key informant for Insurer-based Two cites radiology as the most successful telemedicine application because it affects so many and the data are used for diagnosis and treatment. So much radiological film has been digitized and read that the collection has become a valuable archival teaching and diagnostic tool that doctors routinely consult for unusual cases.

Factors that have contributed to the success of the telemedicine program include passion for the work and the belief that the program was going to increase access to quality care for people.

The key informant defined success of the program from the patient's point of view. Success is when patients feel empowered, when they feel they have a sense of control about their healthcare and feel confident about telemedicine.

24. What future applications for telemedicine do you think would be successful in your organization?

25. If you could change anything about telemedicine in your organization, what would it be?

Academic Medical Systems

Arizona Telemedicine Program

Future applications for Arizona Telemedicine include school health and expansion of telemedicine in Panama, which already has four spoke sites.

The key informant could not think of any changes to the telemedicine program because it already enjoys tremendous support.

East Carolina Telemedicine Program

Applications that the key informant thinks will be successful in the future include homecare for high-risk pregnancies, neo-natal patients, congestive heart failure patients, rehabilitation patients who are difficult to mobilize, and other traumatic brain injury patients. Rehabilitation is clearly an area for expansion, as is the Next Generation Internet Project and a project in which digital electromyography (EMG) and nerve

conductions are done locally by technicians and sent to ECU for reference study and interpretation.

One thing that ECU is working on changing is integrating telemedicine more into operations, particularly integrating it more into the mainstream of the clinical applications, so that it's not just a telemedicine program, but a practice and clinical operations in the medical school. The key informant also expressed a desire for more financial support from university leadership and more recognition for technical telemedicine personnel who have company credentials that do not fit well in an academic system.

Non-Academic Medical Systems

Eastern Montana Telemedicine Network

Short-term plans for Eastern Montana Telemedicine's future include a Neonatal Intensive Care Unit (NICU) project using POTS (plain old telephone system) video, in which video-phones will be sent home with new moms if their babies have to stay in NICU, so that mom can see her baby and connect with her baby from home. A cardiology clinic will soon be connected to the telemedicine network, and if that and cardiovascular surgery follow-ups are successful, those services will be expanded. Still in the planning stages are tele-homecare and occupational medicine, which will support contracts that are being developed throughout the region. Another planned area of expansion is diabetes education, with plans to have Deaconess Billings Clinic's Certified Diabetes Educator (CDE) and nutritionist use the telemedicine network to train nurses and dieticians throughout the region to be providers of these services to their local areas.

One of the things that the organization has done internally is to implement a picture archives and communication (PAC) system, a digital, filmless radiology system. EMTN is pushing that technology out to the regional partners, along with digital patient information software, which will improve communications between the specialty consulting physicians, referring physicians and their patients.

Long-term plans, in the next 3-5 years, are to have a clinical work station in every specialty area that is appropriate for telemedicine within the organization, and eventually a T-3 environment over the system's LAN that can integrate more data.

The only things that the key informant would change would be to have more funding and/or lower telecommunications costs. The network receives incredible support both within the organization and throughout the region and it has an experienced group of site facilitators who have been with the network from the beginning.

Marshfield Clinic TeleHealth Network

The key informant defines future successful applications of telehealth at Marshfield Clinic as any opportunity to have physicians and other health professionals spend more time doing what they were trained to do instead of traveling. The future of telehealth in the region is to extend the scope and services of telehealth at Marshfield Clinic.

The key informant does not see any needed changes because the program was set up with the patient and the provider as the central focus. The telehealth network was

built in such as way as to make the relationship between the provider and the patient the most important element.

State-wide Telemedicine Networks

Kansas Center for TeleMedicine and TeleHealth

Kansas Telemedicine's key informant would like to see occupational telehealth in the future, as well as a stronger home health presence and patient healthcare tutorials. In addition, transitional medical care from the in-patient setting to the outpatient setting, in which the doctor is part of that transition, would allow earlier discharge of some patients.

What the key informant would change would be an integration of outreach services in the state, such as the Office of Rural Health, Office of Health Education Centers, Continuing Medical Education Office, and, of course, the Center for TeleMedicine and TeleHealth. Currently there is no cooperation or coordination of outreach services among these offices that perform very similar functions statewide.

Missouri Telehealth Network

Future applications that would be successful at Missouri Telehealth, according to the key informant, would include Workers' Compensation cases and occupational medicine. A local clinic or hospital connected to specialists via the telehealth network would save an employer both time and money for his injured employee. Large corporations with their own clinics may even become a spoke site in the telehealth network.

Telehealth in public schools is another application that is in the planning stage. Missouri Telehealth Network is teaming with MORNET, the Missouri Research and Educational Network, to install T-1 lines to all of the spoke sites in the network. MORNET's mandate from the state of Missouri is to connect schools and libraries, and sharing that infrastructure helps in reducing telehealth costs as well as opening up the schools and libraries to the network. The school project will be funded by state tobacco settlement money.

Insurer-based Systems

Insurer-based One Telemedicine Demonstration Project

Insurer-based One Telemedicine's key informant believes that the demonstration project will continue to be successful and will only grow as long as it manages resources efficiently and provides needed services.

Changes that the key informant would make would include making telemedicine a separate department and fully funding it.

Insurer-based Two E-Health

Insurer-based Two's key informant believes that disease management and preventative healthcare will be the most successful future applications.

Suggested organizational changes include a corporate environment that is more open and embracing to new technologies and having a greater emphasis on increasing quality and access to healthcare.

CHAPTER V

DISCUSSION

Introduction

Analysis of the key informants' interviews, publications, and grant progress reports was used to determine whether any structural commonalities exist in the telemedicine programs across these different types of organizations to determine whether any unique features exist in the telemedicine programs within each type of organization.

While there are some minor structural differences in telemedicine programs among the different types of organizations in this study and there are many more commonalities.

Research Question One

What is the organizational structure of an academic institution/school of medicine telemedicine network versus a non-academic institution/school of medicine telemedicine network versus a statewide telemedicine network versus an insurer-run telemedicine network? What is the hierarchical structure, funding sources, type and level of staffing?

In some instances organizational structure may be reflected by the name of the organization. There are some name similarities within three of the four types of

telemedicine/telehealth organizations. Both of the academic medical center cases are identified as telemedicine programs. The two non-academic medical center cases are identified as networks: one a telemedicine network and the other a telehealth network. The two statewide systems are identified by the term telehealth: one, a center for telemedicine and telehealth; and the other, a telehealth network. The two insurer-based cases have no terms in common. One is identified as a telemedicine demonstration project and the other as "e-health."

In both academic medical centers, the telemedicine program is located within the medical school, Arizona within the Department of Pathology (Appendix 4A) and East Carolina within the Department of Health Communications (Appendix 5).

Both non-academic-based systems, Eastern Montana Telemedicine Network (Appendix 6) and Marshfield Clinic TeleHealth Network, are integrated within an organization of health clinics: Montana under Marketing and Marshfield under Pro-Active Health Services.

Both statewide networks are headquartered within their state university medical schools: Kansas within the Department of Information Technology (Appendix 7A) and Missouri within the Department of External Affairs (Appendix 8).

All of the telemedicine programs in this study are funded by multiple and diverse sources. All receive grant funding as well as internal support. The two insurer-based programs are funded by state grants. The others are funded by federal grants, primarily from OAT, the Office for the Advancement of Telehealth. All non-insurer-based systems

receive insurance reimbursement. The two state-wide telemedicine networks, as well as one of the academic medical systems, Arizona, receive state line-item funding.

Other sources of funding include network membership fees from the network spoke sites (East Carolina and Eastern Montana) and income from a telemedicine training program (East Carolina).

All of the telemedicine programs, with the exception of the two insurer-based programs that declined to answer, employ a combination of both full-time and part-time staff. Four of the six programs have only three or four full-time employees and four programs have two to four part-time employees.

A statewide system seems to be a particularly efficient way to develop a telemedicine network, particularly within a pre-existing statewide medical system. A combination of state funding and federal grants with local in-house organizational support insures funding for sustainability and growth of the network. Additional services provided through the network, such as in-house training, CME courses, or public health education, add value to network membership and may provide an additional source of revenue for the network.

Telemedicine or telehealth is typically a separate department within the organization, logically located within another, larger department with technology resources, such as radiology, health communications, or patient outreach services.

All of the programs in this study employ a combination of full-time and part-time staff, typically a core of three or four full-time employees and several part-time employees.

Research Question Two

What kinds of human resources are necessary, and what roles must they play? What capabilities are necessary?

While the academic-based telemedicine programs, Arizona and ECU, appear to have an opposite configuration (Arizona, four FTEs, eighteen PTEs; ECU seventeen FTEs, two PTEs), they have some elements in common. Both employ a director, an associate director, a distance education coordinator, project manager/director, telemedicine coordinators, administrative assistant(s), and telemedicine technicians. Arizona's employee structure appears to be more integrated and flexible, while ECU's focus is oriented toward large projects, such as its telemedicine training program and an NLM Next Generation Internet Project.

The two non-academic-based programs, Eastern Montana Telemedicine and Marshfield Clinic TeleHealth, are similarly integrated into their clinic-based systems. Each program supports a full-time director/manager. Additionally, grant funding supports two telemedicine technicians and a telemedicine registered nurse at Montana and two clinicians at Marshfield. Each of the fifteen Montana spoke sites supports a .5 FTE. Part-time employees at Marshfield Clinic TeleHealth include a medical director, an administrative director, information services personnel and a scheduler.

Kansas employs thirteen full-time employees, including four project managers, a project coordinator, two video technicians, and a media production manager. Two part-time employees are research assistants.

Missouri full-time employees include an executive director, an assistant director, an administrative associate and an administrative assistant. Four part-time employees include a coordinator of program and project support, a continuing education coordinator, a network support specialist, and a user support analyst.

Employee roles and capabilities seem to fall into several categories:

1) Administrative, including a director/manager, assistant(s), scheduler(s)

2) Clinical/medical, including medical director, project manager(s), coordinator(s), telemedicine nurse(s)

3) Research, including data collector(s), evaluator(s)

4) Technical support, such as telemedicine engineer(s), technician(s)

Another possible category, education, may include distance education coordinator(s) and assistant(s) and/or telemedicine training coordinator(s) and assistant(s).

In half the organizations in this study, physician specialists are actively involved in developing and overseeing the telemedicine program. Direct involvement of medical

specialists seems to be an important factor in recruiting their colleagues, other specialty physicians, to participate in telemedicine.

Another important telemedicine healthcare professional is a registered nurse. All of the programs in this study employed at least one (and usually more than one) telemedicine RN, who performs a variety of duties from training to coordinating specific projects.

A technical support specialist is another vital member of the telemedicine team. Engineers and/or technicians insure the smooth operation of the telecommunications infrastructure and equipment, the conduit over which the telemedicine network operates.

Other important support personnel for the telemedicine team may include administrative assistants and/or schedulers, evaluation researchers and grant-writing specialists.

Research Question Three

What are the organizational problems and barriers of building, maintaining, and sustaining a telemedicine network?

According to the key informants, the major barriers to building, maintaining and sustaining a telemedicine network are:

1. The cost of telecommunications lines and lack of telecommunications infrastructure

2. Physician participation, both referring and providing

3. Concerns about costs and profitability of the telemedicine network; concerns about limited insurance reimbursement for telehealth services

4. Internal support, organizational politics, lack of understanding, lack of champions, resistance to change

Telemedicine is becoming increasingly accepted by insurance companies as a cost-effective healthcare delivery system. The major remaining barriers of developing and sustaining a telemedicine network fall into two main categories: lack of telecommunication infrastructure or prohibitive cost of using existing infrastructure and reluctance to adopt and support telehealth and telemedicine by healthcare provider administrators and physicians.

Research Question Four

What organizational structure is most conducive for success in a telemedicine network? Success can be defined as sustainability, full use, increased access and diversity of services offered. The definition of success will be determined by the key informants of a particular telemedicine network.

According to the key informants, organizational factors that overcome barriers and influence success and sustainability of a telemedicine program include:

1. Development and implementation of telecommunications infrastructure, what Puskin calls a "televillage"[152]

2. Multiple uses of telemedicine network for telehealth, telemedicine, distance education, and community service and development

3. Formation of an advisory oversight group of key players to identify healthcare needs and to assist in devising and funding network strategies to address those needs.

4. Movement toward integration of telemedicine into departments and physician desktop environments

5. Development and strengthening of relationships between referring and providing physicians and between healthcare providers and consumers.

6. Multiple and diverse sources of funding

7. Support and marketing including in-service training and promotion of telehealth and telemedicine services and external consumer marketing.

Specific Organizational Initiatives

According to the key informants, organizations in this study developed some specific initiatives to help their telemedicine or telehealth program overcome barriers to growth and sustainability.

1. Development and implementation of telecommunications infrastructure for multiple uses (telehealth, telemedicine, and distance education)

> The prospects for sustainable rural telemedicine systems improve when we can use the technology to address a community's broader health information needs through multi-use systems. However, experience also suggests that there are many logistical challenges to building these systems.[153]

While the Universal Services Program helps somewhat with funding, telecommunication costs were specifically listed as a concern for Arizona, East Carolina, Montana, and Missouri.

Arizona, concerned about the lack of telecommunications infrastructure in the state, established Project Nightingale to design and implement the infrastructure necessary to connect healthcare sites to its telemedicine network. The network is a

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[152] Dena S. Puskin, Carole L. Mintzer, and Cathy J Wasem, "Telemedicine: Building Rural Systems for Today and Tomorrow," *Information Networks for Community Health*, Patricia Flatley et al., eds. New York: Springer, 1997, 274, 276.

[153] Ibid., 271.

Dena S. Puskin, "Opportunities and Challenges to Telemedicine in Rural America," *Journal of Medical Systems* 19 (1995), 59.

member of the Arizona Telecommunications System (ATS), a state effort to enhance telecommunications infrastructure.

Missouri Telehealth is working with the Public Service Commission, phone companies, and other interested parties to find ways to obtain a more affordable tariff for T-1 lines for telehealth and telemedicine networks. Missouri Telehealth is also teaming up with MORNET, the Missouri Research and Educational Network, that connects schools and libraries, to share infrastructure resources.

2. Multiple uses of telemedicine network for telehealth, telemedicine, distance education, and community service and development.

In addition to offering clinical services, all of the eight organizations offer some types of educational services. Arizona offers CME (continuing medical education) courses for pharmacists, physicians, and nurses. ECU offers education for public health nurses over the network, while the Kansas network offers community-based public educational series on topics such as diabetes, fibromyalgia, and smoking cessation. .

Eastern Montana offers CME courses, public health education, diabetes education, and precepts (advises) family practice residents in rural areas. The network also has a unit in the local office of the Montana Hospital Association so that members of the network may "virtually" attend association meetings without long-distance travel.

Missouri Telehealth offers CME courses and has two area health education centers where third year residents are precepted or advised by overseeing physicians. Marshfield Clinic uses its network for an internal employee assistance counseling service.

3. Formation of an advisory oversight group of key players to identify healthcare needs and to assist in devising and funding network strategies to address those needs.

The Arizona Telemedicine Council was established with key members of the state legislature and other key people in healthcare, and telecommunications to report progress and areas of need for future development.

Eastern Montana formed a telemedicine advisory group to oversee the network. The advisory group is composed of two members from each telemedicine network site, usually the administrator and site facilitator, plus representatives from all of the telecom carriers, representatives from local higher education, and urban and rural physicians. EMTN is a member of the Montana Healthcare Telecommunication Alliance, an organization that advocates for telemedicine throughout the state. EMTN publishes a quarterly newsletter that is distributed to healthcare providers throughout the region.

Missouri Telehealth established community advisory groups, composed of medical personnel and representatives from schools, business, industry, public health, and university extension services, to present progress reports and solicit input about

community healthcare needs. In addition, the network in working toward the development of a state telehealth advisory group

4. Movement toward integration of telemedicine into departments and physician desktop environments.

East Carolina University is working to make telemedicine more integrated and convenient to providers by offering store-and-forward technology to dermatologists and by developing an Internet II pilot project.

Eastern Montana Telemedicine's goal in the next few years is to have a clinical work station in every specialty area that is appropriate for telemedicine within the organization. The network has already implemented a PAC (picture archive and communication) filmless radiological system as part of a large, integrated organizational information technology strategy that will improve the ability to communicate with referring physicians and their patients.

E-mail is an increasing important element in two of the networks. Marshfield Clinic is experimenting with sending digital dermatology pictures as e-mail attachments so that the doctor can review those at will in a convenient and timely fashion. Missouri Telehealth ensures that Internet and e-mail services are functioning at each site in the network to enhance communications between network members.

5. Development and strengthening of relationships between referring and providing physicians and between healthcare providers and consumers.

Arizona Telemedicine purchases ½ day clinic times from University Medical Center departments to furnish physicians in a needed specialty to work afternoons for the telemedicine network. The network conducts site surveys to assess community needs. The Arizona program is multi-cultural – it has outreach services to increase access to healthcare services in Native American and Hispanic communities.

East Carolina markets telemedicine both internally and externally. New ECU Medical Center faculty members are given an orientation "test drive" of the equipment. The new providers do mock telemedicine consultations with rural sites. The administration expects medical faculty to use telemedicine as a part of their faculty responsibilities. ECU Telemedicine team members attend community outreach events, routinely visit new spoke sites, and publish a regional newsletter.

Eastern Montana, as well as Marshfield Clinic, requires physician participation in telemedicine as part of their association with the clinics, and both compile and distribute progress reports as a way of communicating the value of network membership.

The Kansas key informant believes in contracting for a specialty telemedicine service for a fee, such as contracting with pediatric cardiology to set up a pediatric cardiology telemedicine service. This practice greatly reduces or eliminates provider resistance.

6. Multiple and diverse sources of funding.

East Carolina Telemedicine generates extra funding for its program with a large international telemedicine training program. ECU also generates funding by charging a network membership fee.

Eastern Montana also charges a fee for network membership and, additionally, each member is required to furnish a .5 employee dedicated to the telemedicine network. EMTN sells network time to non-healthcare providers (individuals, groups, or businesses). Recently, a couple leased network time for a long-distance consultation with an architect.

Arizona, Kansas, and Missouri are funded by their states. Each also has federal grant funding. Both Kansas and Missouri are funded in part by state tobacco settlement funds, which will be used to expand their programs.

7. Internal support, including training and promotion of telehealth and telemedicine services.

Arizona offers multi-faceted training. When a new site comes on-line, a group of six to eight persons, usually the CEO, Medical Director, Telemedicine Director, Telemedicine Coordinator, a technical person, and physicians, receives two days of training at the Telemedicine Training Center at Tucson. A follow-up case manager and coordinator are sent to the spoke site for training within a couple of weeks. Legislators

and the Telemedicine Council have a one-day training session, and two orientation and demonstration sessions are available. Arizona also hosts an annual Corrections Conference, which breaks even financially.

New faculty members at ECU Medical Center are routinely oriented to telemedicine by conducting mock consultations with rural sites to become comfortable with the technology.

Comments

Several of these initiatives seem particularly useful in developing, sustaining, and growing telemedicine networks. Statewide telecommunications infrastructure with cooperative networks, including schools and libraries as well as hospitals and clinics, could reduce costs and maximize usefulness.

Complementing and supporting the infrastructure initiative, an advisory group may consist of key players, such as state legislators; medical professionals and administrators; representatives from the telecommunications industry, higher education and professional healthcare education; and representatives from the telemedicine network.

Advisory groups serve three important functions. First, they can be instrumental in assessing statewide needs and in recommending development of network programs and services to address those needs. Second, key players from state government and the telecommunications industry may play key roles in supporting the development of a cost-

effective network infrastructure. Third, the inclusion of healthcare professionals, particularly healthcare educators and administrators, could promote the adoption and integration of telemedicine within the state's community of healthcare providers.

Marketing strategies could play an important role in expanding telemedicine and telehealth networks. Internal training and marketing of telemedicine promote the adoption of telehealth technologies and use of the network by healthcare professionals. Effective external marketing strategies may increase utilization of a telehealth network "by making consumers aware of the telehealth system's ability to deliver quick, convenient and comfortable access."[154] Strategic marketing could increase public demand for telehealth services, which could also fuel provider acceptance and adoption.

Telemedicine Theory

Cybernetic Model

Cramp and Carson' cybernetic healthcare model [155] may be modified to reflect more specifically a telehealth system. Figure 22 illustrates a simplified conceptual model of telehealth dynamics.

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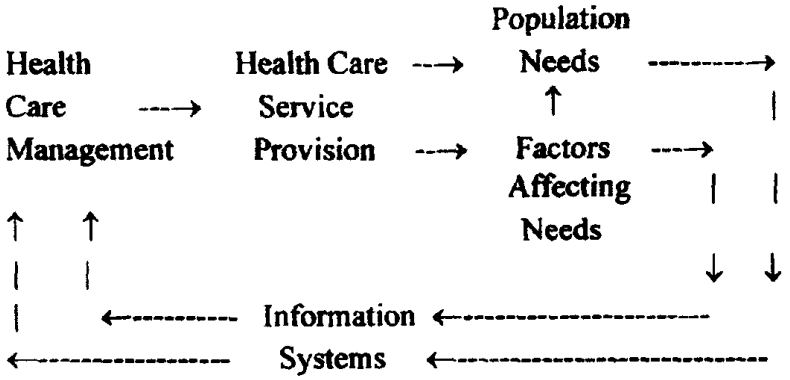
[154] Susan L. Dimmick and Samuel G. Burgiss, "Marketing Strategies for Telehealth Programs." In *Telecommunications for Nurses: Providing Successful Distance Education & Telehealth*, 2nd Edition, M.L. Armstrong and S. Frueh, eds. New York: Springer Publishing, 2002.

[155] Derek G. Cramp and Ewart R. Carson, "A Model-Based Framework for Public Health: A Vehicle for Maximising the Value of Telecare?" S Laxminarayan, ed., *Proceedings of the 3rd IEEE EMBS International Conference on Information Technology Applications in Biomedicine (ITAB 2000)*, Piscataway, NJ: IEEE, 2000, 272-277.



Cramp and Carson's Simplified Conceptual Healthcare Model[156]

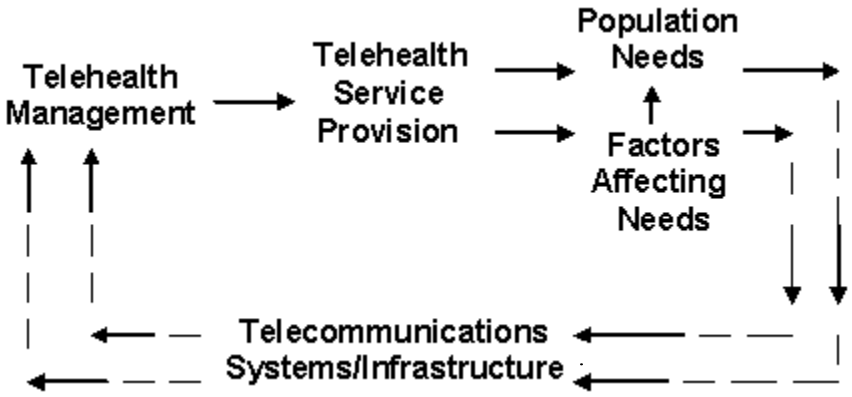


Figure 22.
Simplified Conceptual Telehealth Model
A Modification of Cramp and Carson's Simplified Conceptual Healthcare Model[157]

[156] Crook and Carson, 275.

[157] Ibid..

Three of the main components of the model are telehealth management (decision-makers), telehealth service provision, and the target population, with telecommunications systems and infrastructure supporting management and providing a feedback loop. This feedback loop is particularly important in the telehealth model because "healthcare practiced from a distance" is completely dependent on the underlying telecommunications systems and infrastructure.

Diffusion of Telemedicine

Mapping the results of this study to the Diffusion of Innovations Model illustrates some of the conditions that affect adoption and diffusion of telemedicine.

While none of the key informants used Roger's term of *opinion leaders*, they all mentioned the importance of the committed, influential individuals within their organizations with such descriptive terms as *champions* or *cheerleaders* of telemedicine.

"Compatibility with values and needs of adopters," "perceived complexity of use," "trialability and observability" are some of Roger's innovation characteristics that were not expressed verbatim, but were alluded to by the key informants' emphasis on the importance of making telemedicine convenient for the physicians and of making telemedicine visible through marketing and training. Some of the key informants' organizations require or encourage new physicians to do a "trial run" or "test drive" the equipment to increase familiarity and comfort levels.

The other characteristic of innovation adoption, "perceived relative advantage," identifies the problem that telemedicine has in becoming more widespread within the general population of healthcare providers. Telemedicine is a patient-centered technology, delivering healthcare services to the patient, either in the home or in a local, more convenient facility. Telemedicine has little perceived relative advantage for physicians and other healthcare providers who are accustomed to having patients come to them. Early adopters have done so not because of personal advantage, but from a desire to use technology to increase access to healthcare to underserved populations.

While there are legitimate physician concerns about privacy, legality, and reimbursement, the larger underlying issue seems to be the paradigm shift from a provider-centered to patient-centered model of healthcare.

Up until the early to mid-twentieth century, it was common practice for physicians to visit the patients' homes to deliver healthcare. In recent years, such home visits are rare and most physicians have adopted a provider-centered, business model in which the patients must travel to a physician's office or medical center for healthcare.

Telemedicine is one solution that addresses the increasing problem of little or no access to healthcare for underserved populations living in rural or isolated areas. In particular, the elderly and poor often have difficulty traveling to healthcare centers for specialty consultations or for monitoring of chronic conditions.

Critical Mass

According to Markus' Critical Mass Theory of Interactive Media,[158] universal access, interdependence, and diffusion are necessary to achieve critical mass, the number of early adopters sufficient to fuel the widespread adoption of an innovation.

Universal access and interdependence may be addressed for telemedicine by the development of better and more cost-efficient telecommunications infrastructures and systems. An integrated telecommunications infrastructure is necessary for ubiquitous, universal desktop access to healthcare. Statewide telecommunications networks could link healthcare providers with healthcare consumers and allow efficient, long-distance monitoring of chronic diseases and/or conditions.

The third factor, diffusion, could be enhanced by the integration of telemedicine technology into professional healthcare education and by in-service training of existing providers. The adoption of telemedicine and telehealth may be part of a general trend toward such patient-centered, integrated technologies as electronic multimedia patient records and "smart cards," small portable plastic cards encoding patients' health information.

Recommendations for Developing, Growing, and Sustaining a Telehealth Network

Based on this study's data collection and analysis, the following organizational factors are recommended for developing, growing, and sustaining a telehealth network:

[158] Markus, 491-511.

1) Development of statewide telehealth networks as part of larger statewide and national telecommunication infrastructure linking schools, libraries, hospitals, and clinics for multi-dimensional purposes of education, healthcare, and community development

2) Multiple sources of funding including state funding, federal grant funding, and internal institutional support. If state funding is not available, other strategies may be required, such as a network membership fee, a fee for deliverables such as distance training or CME courses, or a fee for specific telehealth services.

3) Development of integrative, multimedia electronic patient records, secure but accessible by healthcare providers and by patients

4) A telehealth advisory oversight group composed of key players in state government, higher education, the telecommunications industry and healthcare education and administration. Objectives of the group should include identification of healthcare needs and the development of funding and implementation strategies to meet those needs via the telehealth network

5) Integration of telemedicine training into physician education and residency programs, and in-service telemedicine training of existing healthcare providers

6) Adequate staffing of telehealth networks, including a director and/or medical director (physician), tele-nurse(s), engineer(s) and/or technician(s), and scheduler(s) and/or administrative assistant(s). Other staff may include project coordinator(s), research evaluator(s), and education coordinator(s) and/or trainer(s).

7) Marketing of telemedicine and telehealth services to the public and to referring and specialty healthcare providers.

Recommendations for Further Study

Recommendations for future study include: refining and expanding telemedicine taxonomy and typology; further developing and refining telemedicine theory; refining and expanding the survey instrument for broader survey or case study research; and further research into more specific areas such as budgets and salary ranges.

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APPENDIX 1.

The University of Tennessee

Office of Research
Research Compliance Services

INFORMED CONSENT FORM

"Organizational Structure of Telehealth Care: An Examination of Four Types of Telemedicine Systems"

You are invited to participate in a research study. The purposes of this study are:

- To examine the infrastructure of selected telemedicine organizations and, from this, develop a model that can enhance network sustainability and growth
- To develop an internet survey instrument to determine organizing infrastructure on a nationwide basis.

The research is being conducted in partial fulfillment for a doctoral dissertation

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INFORMATION

- The case study method will be used to determine the organizational structure and location of the telemedicine network within the larger "parent" organization. The original purpose of the networks will be examined, as well as the history of their development and factors that contributed to and detracted from network development. Such factors could be, but are not limited to, funding sources; health care provider and patient acceptance; technical factors; location within the parent organization; availability or non-availability of reimbursement; and other factors that could be discovered through in-depth interviews with key informants within the telemedicine network under study.

  Data sources include:
  - Transcripts of interviews
  - Documents sent by case study participants
  - Case study participants' web sites and marketing materials
  - Research publications.

- Key informants from eight different telemedicine networks will be asked to participate in the study.
- Participants will be furnished the interview questions (in advance, online) that will guide the interview. The 'virtual' interview will use interactive audio-video technology in the University of Tennessee Medical Center Telemedicine Department.
- The interview is anticipated to last approximately an hour. If more information is needed, follow-up phone-calls and/or e-mails may be used.
- The data collection time frame is May to July 2001.
- The interviews will be audio-taped and transcribed. The audio-tapes, informed consent forms, and any other materials containing key informants identities will be kept securely and will be destroyed after analysis. Access to the identifying materials will be restricted to the Principal Investigator, Teresa Welsh, and her advisor, Dr. Susan Dimmick.

RISKS

There are no foreseeable risks to the participants.

BENEFITS

The only benefits for participation in this study will be in furthering research and in increasing the body of knowledge in the field of telemedicine.

CONFIDENTIALITY

The information in the study records will be kept confidential. Data will be stored securely and will be made available only to persons conducting the study unless you specifically give permission in writing to do otherwise. No reference will be made in oral or written reports that could link you to the study.

CONTACT

If you have questions at any time about the study or the procedures, (or you experience adverse effects as a result of participating in this study,) you may contact the researcher, Teresa Welsh, at the University of Tennessee College of Communications, School of Information Sciences, at 865.974.3597 or at 865.573.5030. If you have questions about

your rights as a participant, contact the Research Compliance Services section of the Office of Research at 865.974.3466.

PARTICIPATION

Your participation in this study is voluntary; you may decline to participate without penalty. If you decide to participate, you may withdraw from the study at anytime without penalty and without loss of benefits to which you are otherwise entitled. If you withdraw from the study before data collection is completed, your data will be returned to you or destroyed.

CONSENT

I have read the above information and agree to participate in this study. I have received a copy of this form.

Participant's name (print) _____

Participant's signature _____

Date _____

APPENDIX 2.

TELEMEDICINE/TELEHEALTH
KEY INFORMANT INTERVIEW QUESTIONS

BACKGROUND QUESTIONS

1. What is the official name of your telemedicine/telehealth system?

2. Is that the original name or has the name changed over time?

3. When and how did telemedicine begin in your organization?

4. Was any sort of needs assessment done in the beginning stages?

5. Is telemedicine a separate department or is it integrated into other departments?

6. How many full-time employees work in your telemedicine system?

7. How many part-time employees?

8. Using Grigsby's classification scheme,[159] which general applications and processes of telemedicine do your organization provide?
    a. Initial urgent evaluation and triage

[159] Jim Grigsby, Robert E. Schlenker, Margaret M. Kaehny, Peter W. Shaughnessy, and Elliot J. Sandberg, "Analytic Framework for Evaluation of Telemedicine," *Telemedicine Journal* 1 (1995), 36-37.

b. Medical and surgical follow-ups
c. Primary care consultations
d. Specialty consultations and second opinions
e. Transmission of digital diagnostic images
f. Diagnostic work-ups for specific conditions
g. Monitoring of chronic diseases and conditions
h. Transmission of medical data
i. Public health and education
j. Other

9. Using Reid's classification scheme of telemedicine (Level of Service, Setting, Healthcare Discipline, Technology Used, Equipment, Data Type, Activity Conducted),[160] what level of service(s) does your organization provide?
    a. Tele-Consultation
    b. Tele-Care
    c. Tele-Monitoring/Mentoring
    d. Tele-Health Education
    e. Other

10. What are the settings (end-user locations)?
    a. Hospital
    b. Clinic
    c. Home
    d. Prison

[160] Jim Reid, "Telemedicine Applications: Today and in the Future," slide presentation (1998). Available at www.telemedprimer.com/htb1198/tsld001.htm.

e. Workplace
f. Other

11. What healthcare disciplines use your telemedicine system?
    a. Medical specialty (Family Practice, Dermatology, etc.)
    b. Nursing (Acute care, Home health, Hospice)
    c. Allied health (PT, OT, Nutritionist, etc.)
    d. Other

12. What telemedicine technology system(s) are used by your organization?
    a. Interactive video
    b. Store & Forward
    c. Other

13. What kind(s) of equipment is used in this system?
    a. Room systems
    b. Rollabouts
    c. PCs
    d. Mobile
    e. Set top boxes
    f. Other

14. What kind of activity is conducted with telemedicine in your organization?
    a. Clinical
    b. Educational (Adult, Medical, Nursing, Allied)

c. Administrative (Meetings, Recruitment, Compliance Q&A)
d. Business (Community business, Social orgs, Government orgs)
e. Other

15. How is your telemedicine system funded?
    a. Grants
    b. In-house
    c. Insurance reimbursement
    d. Other

16. Does your organization collect data and generate reports on telemedicine activity?
    a. What kinds of data are collected?
    b. Who compiles the data and writes the report? An independent evaluator?

17. Does your organization offer any training in telemedicine? If so, for whom and what kind?

18. Does your organization market or publicize telemedicine to healthcare consumers? … to healthcare professionals? If so, what kind?

EVALUATION QUESTIONS

19. What do you consider the greatest barriers to the growth of telemedicine in your organization?

20. What efforts has your organization made (if any) to overcome those barriers?

21. Which telemedicine applications do you consider the most successful in your organization?

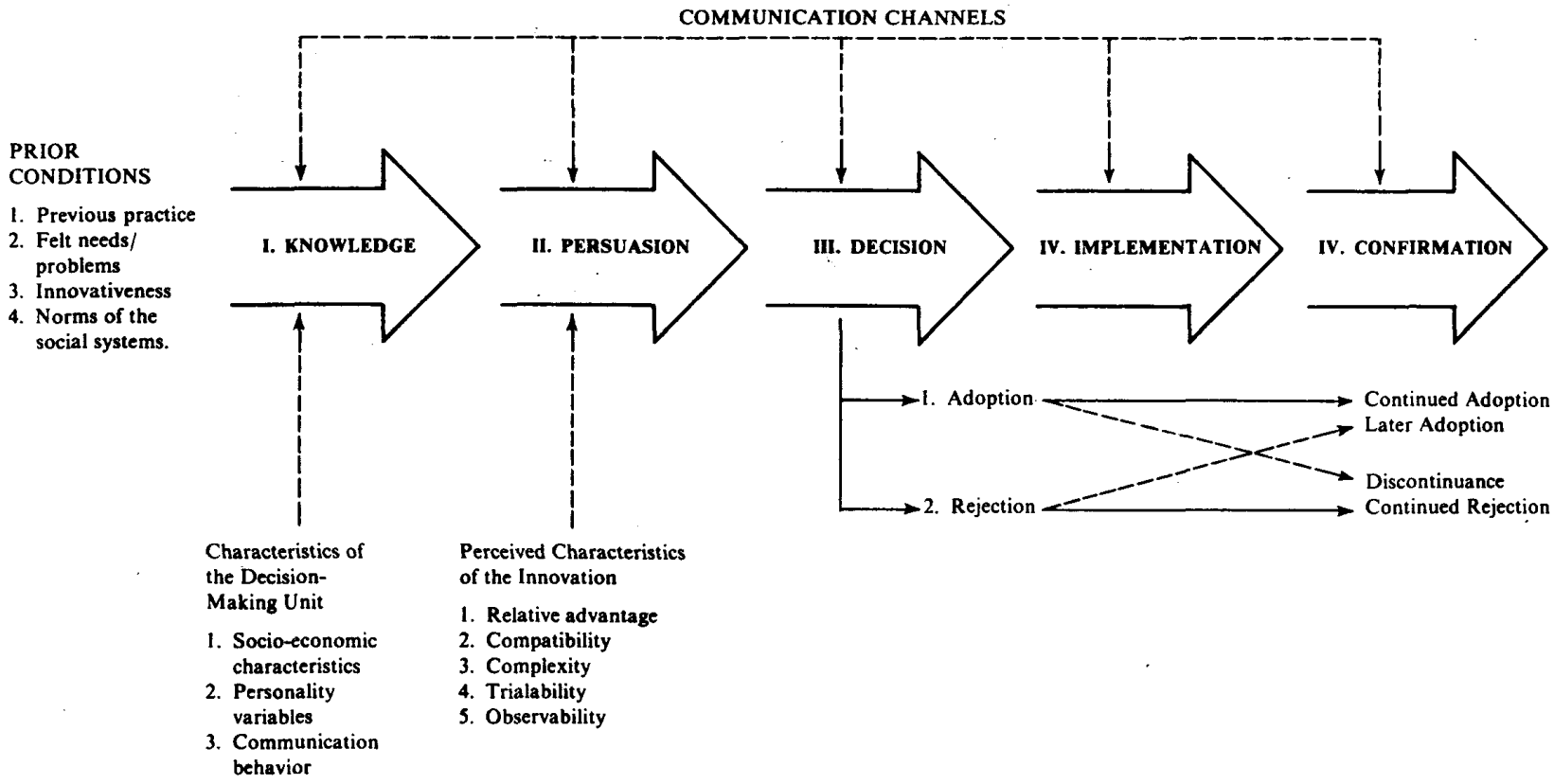
22. What factors do you think have contributed to the success of these applications?

23. What do you define as success in your TM program?

24. What future applications for telemedicine do you think would be successful in your organization?

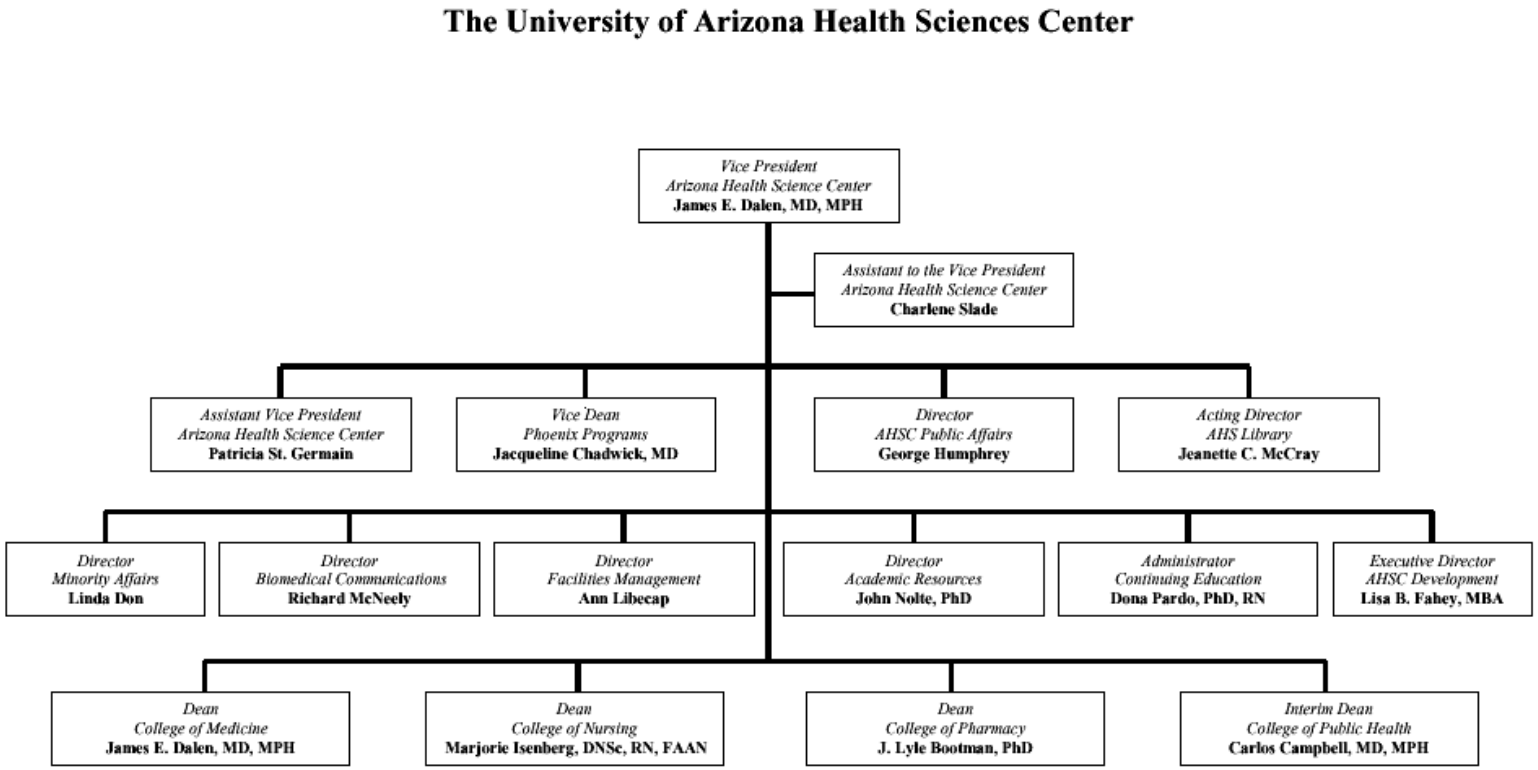
25. If you could change anything about telemedicine in your organization, what would it be?

APPENDIX 3. DIFFUSION OF INNOVATIONS MODEL[161]

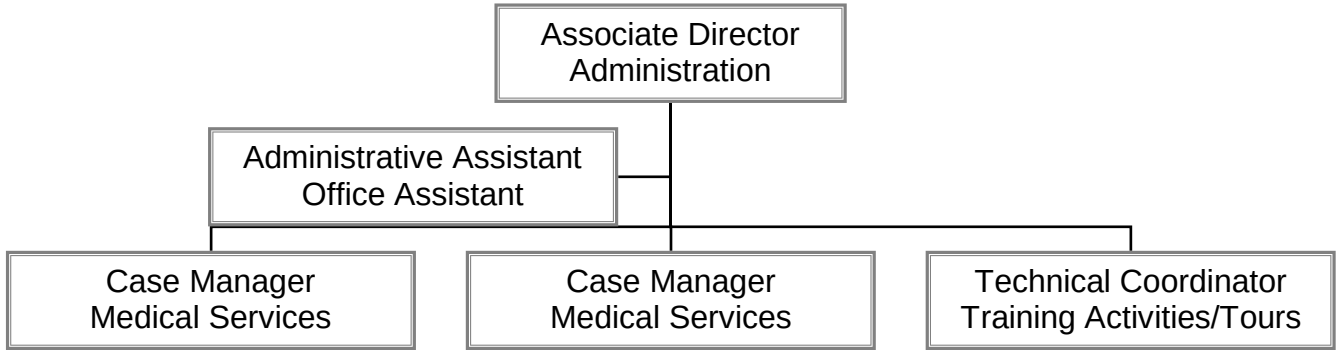


[161] Everett Rogers, *Diffusion of Innovations*, Fourth edition (New York: The Free Press, 1995), 165.

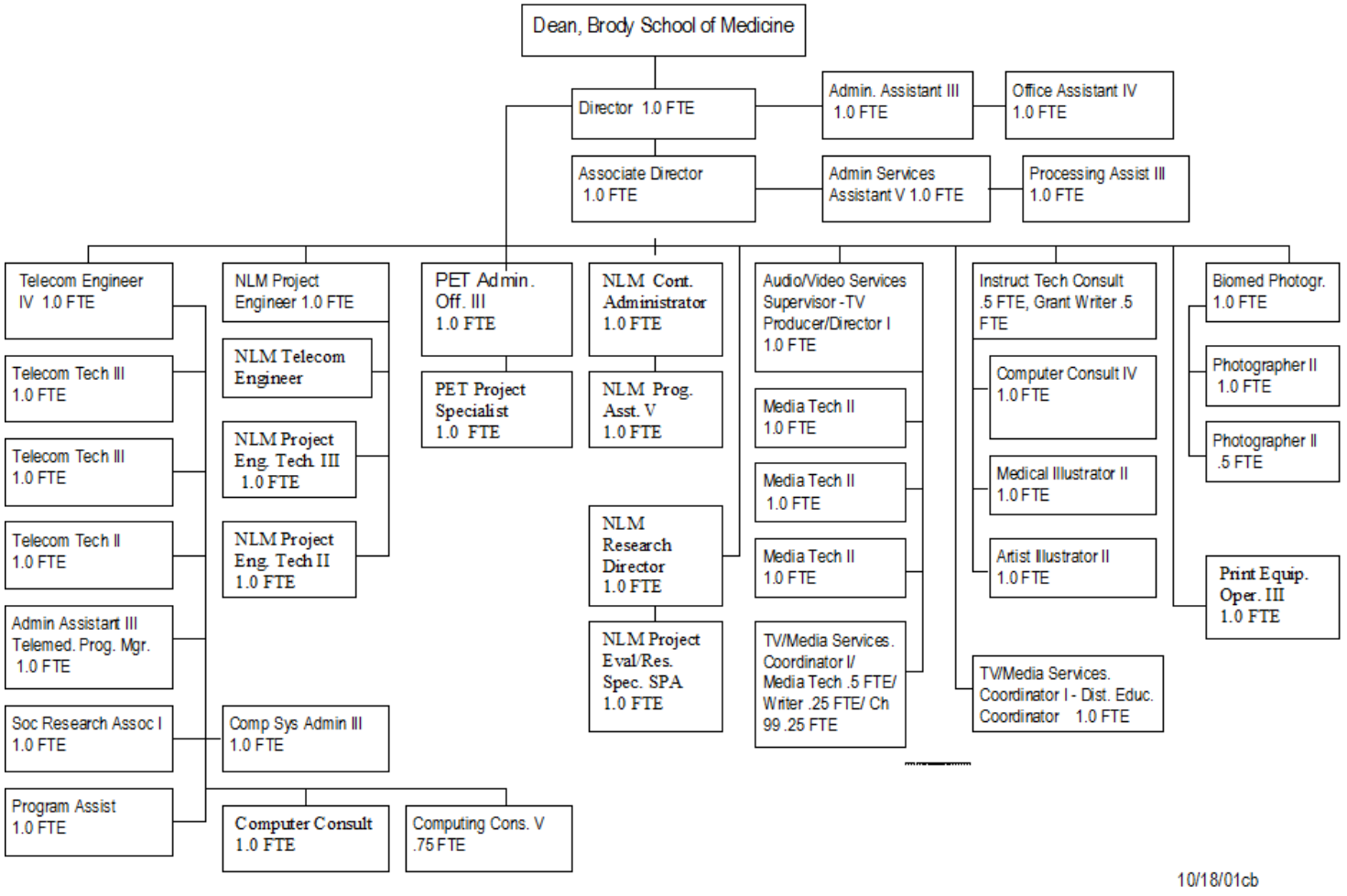
APPENDIX 4A. ARIZONA HEALTH SCIENCES CENTER ORGANIZATIONAL CHART



APPENDIX 4B. ARIZONA TELEMEDICINE PROGRAM ORGANIZATIONAL CHART

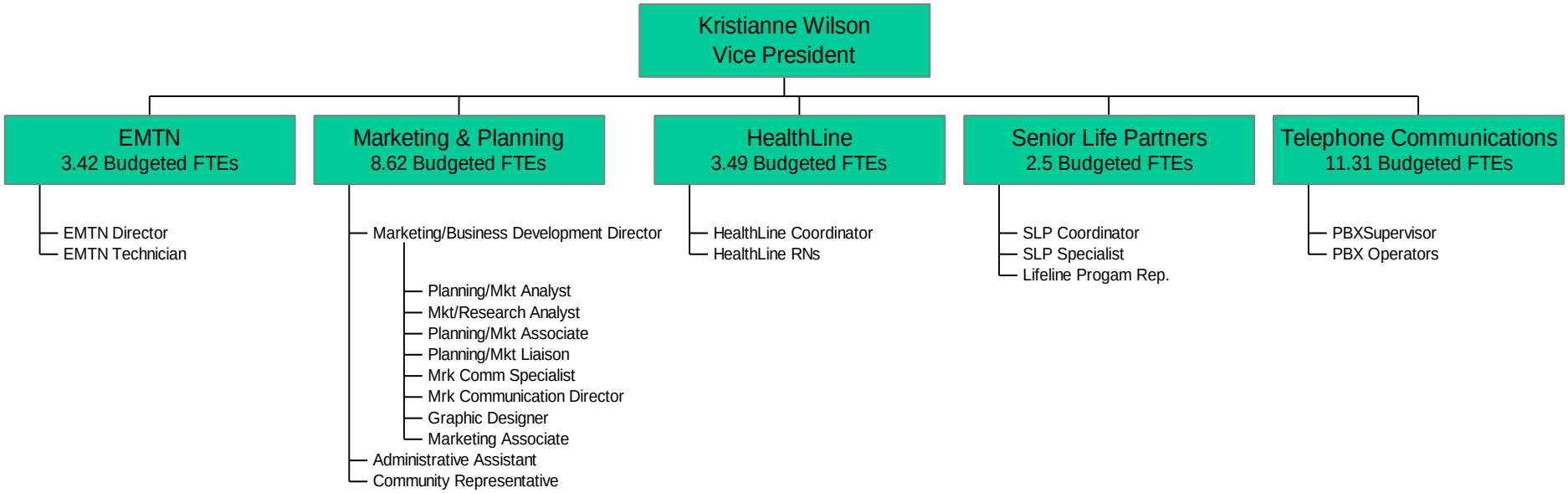


APPENDIX 5. EAST CAROLINA UNIVERSITY TELEMEDICINE ORGANIZATIONAL CHART


Dean, Brody School of Medicine
Director 1.0 FTE
Admin. Assistant III 1.0 FTE
Office Assistant IV 1.0 FTE
Associate Director 1.0 FTE
Admin Services Assistant V 1.0 FTE
Processing Assist III 1.0 FTE
Telecom Engineer IV 1.0 FTE
Telecom Tech III 1.0 FTE
Telecom Tech III 1.0 FTE
Telecom Tech II 1.0 FTE
Admin Assistant III Telemed. Prog. Mgr. 1.0 FTE
Soc Research Assoc I 1.0 FTE
Program Assist 1.0 FTE
NLM Project Engineer 1.0 FTE
NLM Telecom Engineer
NLM Project Eng. Tech. III 1.0 FTE
NLM Project Eng. Tech II 1.0 FTE
Comp Sys Admin III 1.0 FTE
Computer Consult 1.0 FTE
Computing Cons. V .75 FTE
PET Admin. Off. III 1.0 FTE
PET Project Specialist 1.0 FTE
NLM Cont. Administrator 1.0 FTE
NLM Prog. Asst. V 1.0 FTE
NLM Research Director 1.0 FTE
NLM Project Eval/Res. Spec. SPA 1.0 FTE
Audio/Video Services Supervisor -TV Producer/Director I 1.0 FTE
Media Tech II 1.0 FTE
Media Tech II 1.0 FTE
Media Tech II 1.0 FTE
TV/Media Services. Coordinator I/ Media Tech .5 FTE/ Writer .25 FTE/ Ch 99 .25 FTE
Instruct Tech Consult .5 FTE, Grant Writer .5 FTE
Computer Consult IV 1.0 FTE
Medical Illustrator II 1.0 FTE
Artist Illustrator II 1.0 FTE
TV/Media Services. Coordinator I - Dist. Educ. Coordinator 1.0 FTE
Biomed Photogr. 1.0 FTE
Photographer II 1.0 FTE
Photographer II .5 FTE
Print Equip. Oper. III 1.0 FTE
10/18/01cb

APPENDIX 6. EASTERN MONTANA TELEMEDICINE NETWORK (EMTN) ORGANIZATIONAL CHART

Deaconess Billings Clinic
Marketing Division



APPENDIX 7A. KANSAS UNIVERSITY INFORMATION RESOURCES ORGANIZATIONAL CHART

Information Resources Associate Vice Chancellor for Information Resources Chief Information Officer Director, Dykes Library		Assistant to the CIO

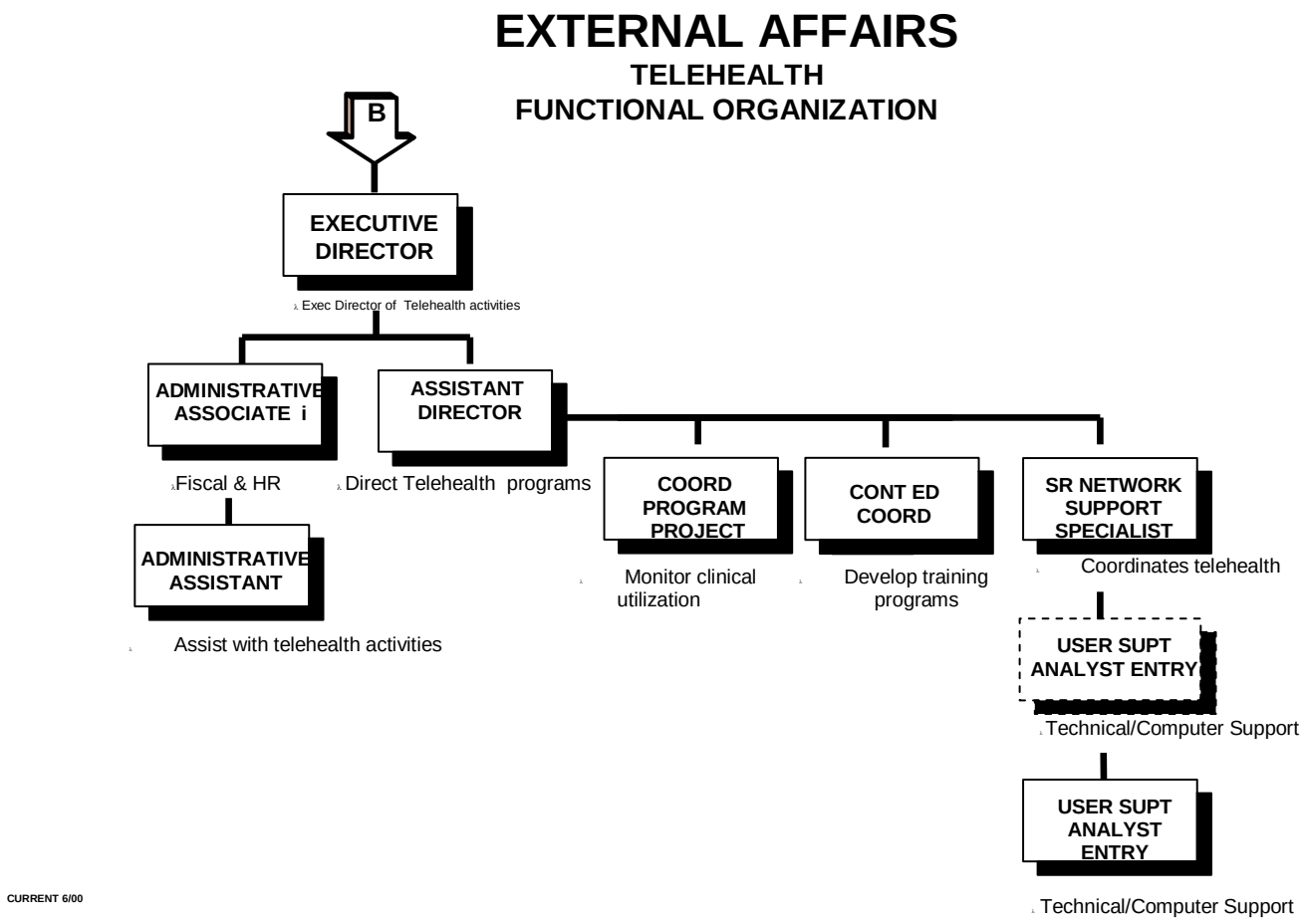
Academic Technology Director	**Administration**	**Dykes Library**	**Administrative Systems** Director	**Internet Development** Asst. Director	**Telecom & Networking** Director	**Telemedicine** Director	**Data Integration** Director	**Security** Security Administrator
Instructional Multimedia	Budget/ Financial	Circulation	Analysis & Programming	Internet Development Services	Networking	Clinical Issues & Research	Systems Integration	
Digital Audio and Video	Billing	Interlibrary Services	Production Services	Server Management	Customer Services	Scheduling & Services	Data Warehouse Development	
Faculty Support	Purchasing	Reference	Document Management		Installation & Maintenance			
Student Computing	Contracts	Technical Services			Paging			
	Admin Support	Systems			Telephone Services			
	Personnel/Payroll				Help Desk			

APPENDIX 7B. KANSAS UNIVERSITY TELEMEDICINE ORGANIZATIONAL CHART

TELEMEDICINE
Director

Senior Consultant (MD)

Senior Coordinator (MBA)

Researcher	Media Production Technician	Media Production Technician	Secretary	Telehospice Researcher	TelekidCare Researcher (MA)	Scheduling Coordinator	Researcher	TelekidCare Coordinator	Telehospice Coordinator (RN)	Researcher

APPENDIX 8. MISSOURI TELEHEALTH NETWORK ORGANIZATIONAL CHART